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# THE ELEMENTARY SCHOOL TEACHER

## APRIL, 1911

## SUPERINTENDENTS' AND PRINCIPALS' ASSOCIATION OF NORTHERN ILLINOIS

DEKALB, ILLINOIS, MAY 5 AND 6, 1911

## REPORT OF COMMITTEE OF SEVEN ON AN OUTLINE COURSE OF STUDY ON A SCIENTIFIC BASIS

### SPECIAL SUBJECT—ELEMENTARY SCIENCE

*Committee of Seven*

DANIEL A. TEAR, Chicago, *Chairman*

H. A. BONE, Batavia
M. G. CLARK, Streator
R. G. JONES, Kewanee
IRA B. MEYERS, Chicago
JESSE L. SMITH, Highland Park
C. W. WHITTEN, DeKalb

### PROGRAM

*Friday, May 5,* 1:30 P.M.

REPORT OF THE COMMITTEE OF SEVEN, ON ELEMENTARY SCIENCE—
General Statement: DANIEL A. TEAR.
Fundamental Principles: M. G. CLARK.
The Course of Study—
The Primary Period, including the Kindergarten: Discussion led by IRA B. MEYERS.

*Friday, May 5,* 7:30 P.M.

The Course of Study (*continued*)—
The Intermediate Period: Discussion led by H. A. BONE AND JESSE L. SMITH.

*Saturday, May 6,* 8:30 A.M.

BUSINESS SESSION.
The Course of Study (*continued*)—
The Adolescent Period: Discussion led by C. W. WHITTEN.

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A. M. BLOOD, Park Ridge.....Vice-President
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## SCIENCE IN THE SCHOOL: ITS PLACE AND PURPOSE

Science finds its place in the school through the child's need of science information or science experience. It is probable that this need is not often consciously felt by the child, but whenever he is so conditioned in his relations with his environment—nature, social, industrial, etc.—that science information or science experience would enable him to react more intelligently to that environment and thus give him greater efficiency in meeting his problems, then we say that the child has a "need of science," a need that should be met at such a time and in such a way that it will prove most helpful to the child. In the early grades we can hardly, perhaps, call either the material of study "science" or the method of approach technically "scientific." Throughout the grades, however, the purpose of the science course should be so to meet these needs as to give to the child an experience of the various phases of his environment that will differentiate into those more technical and scientific investigations which his developing experiences, interests, and broadening opportunities will demand. If, in this way, we meet the child's needs of today we best prepare him for the larger, deeper needs of tomorrow.

Again, if the course of study in the lower grades is based upon the child's nature, social, and industrial environment, and has been planned to meet the child's developing needs; if this mass of thought-material and its motor expressions has been definitely worked out along the same lines and in accordance with the former reports of this committee; then nature-study and elementary science must constitute an important part of the subject-matter for these grades. The home life, the neighborhood life, and the industrial life of the community have furnished science material more abundantly than the school has been able to take advantage of. The child in the kitchen must experience the problem of boiling, freezing, and evaporating water, and there is constantly open to him something of the problem of home and community sanitation; the home garden introduces him to all the secrets of germinating, growing, flowering, and fruiting plants as well as to the various forms of insect and animal life that enter into the garden economy; his constantly expanding world experiences should lead him to the investigation of his geographical and elementary geological environments; the neighborhood brings its problems of scientific co-operation; and so one series of problems after another forces itself upon the child's attention and gives ample basis for the elementary science of the schools. It is not the "finding" of material but rather the "elimination" of material that becomes the serious problem of the teacher. The real work of the teacher in this field of the child's interests is so to direct the child's activities that he will be really appreciating, organizing, and controlling his more fundamental science experiences. At this stage there are

no separate sciences. It is a study of the child's daily experiences. It is, in embryo, a study of all the sciences.

In the higher grades the problems gradually tend toward a specialization of the subject, but the danger is in specializing too rapidly rather than in continuing too long the unifications of the science material with the general subject-matter of the grade. We must never forget that the subject-matter of the grades, so far as it has an excuse for being at all, is a response to the needs of the expanding community life of the child and must find its interpretation in that life. All the departments of school activity demand an understanding of science facts and each of these, in turn, will suggest or require other facts which will keep the child constantly in touch with his science environment. It is not sufficient that the child talk about springs, wells, flood plains, or the general effect of frost and weather upon the rocks and soil. He should see these things, experience them in nature, and work them over in the classroom laboratory. Construct a spring in the sand pan, dig a well, disintegrate rocks, make drawings of all the observable phenomena and write up their history. Here again we should observe that the elementary-science course cannot be a formal statement of science facts to be taught in every school. To a great extent the course should depend upon the industries of the community and natural environment of the child. The children in the neighborhood of Highland Park, for example, have a nature environment that should enter largely into their science work, but such work would be without meaning to the children of Streator. Ottawa, LaSalle, and Peru have a natural means for geographical and elementary geological investigation which gives them a great advantage over the schools of many other parts of the state and should place them among the leaders in that line of science study. Streator and many other cities must depend more largely upon their industrial advantages, while the country schools have a rich field in their agricultural opportunities. If these varied opportunities were used by all schools, as they some time will be, we should find them affecting more largely the life-interests of their graduates. Highland Park should become the birthplace of naturalists, Ottawa of geologists, and Streator of captains of industry. It is to these needs that the course of study should give heed. If the course of study is scientifically planned the child is constantly thinking and investigating more deeply into his industrial and nature environment, his experiences are demanding a better and truer understanding of all these problems, and science will find the child, again and again, knocking at the door for necessary information. If the real needs of the various fields of activity are taken care of, the work of the earlier years will have built up a basis of science material and science experiences ready for organization that should double the value and efficiency of the later school work.

Little needs to be said of the science organizations of the high school more than that they should meet the industrial and economic demands of the community life first, and the demands of the higher institutions of learning

second. The great majority of the high schools, if they are to serve their communities, must choose their science more from the standpoint of the needs of agriculture, horticulture, and the field of home industries and home economics than they have done in the past. The child feels but little or no need for botany, zoölogy, and chemistry as now taught in our high-school courses. He does need, because of his community environment, a scientific knowledge of elementary agriculture which should carry him into a far more intelligent scientific and economic study of plant and animal life. Here is the real high-school field for botany and zoölogy. Again, the pupil needs a chemical knowledge of soils and soil reactions and, in industrial communities, of clays, sands, minerals, and the means for their reduction and use. He needs to know the physics of heating and lighting plants, of gas manufacture, and of the practical appliances of the hundred and one things of the community life. In other words, the science courses of the high school should be organized about the community problems, and when this shall have been accomplished a course will have been organized that will form a practical basis for the more technical work of the college and university.

The public school, then, is not the place for the development of science "for science' sake" or from the more purely scientific standpoint. Its purpose is to give the child an understanding of his daily reactions and to give meaning and point to all his relations in the social and industrial world. If it does all this, and does it efficiently, it will at the same time, for those who are so situated that they can heed the call, so engage the interests of the pupil as to cause him to desire a more thorough and better organized scientific experience.

## THE CHILD AND NATURE

This report is based upon the work of the Committee of Seven for the preceding five years. It has been the purpose of the committee not to depart from the fundamental lines laid down in previous reports. It accepts the proposition that education is a process of adjustment; that conscious intellectual development and the higher aspirations and ideals of man, as well as the organized physical and social activities by which man accomplishes his ideals, are the outgrowth of fundamental necessities essential to all living beings. Out of the struggle to live there is born a conception of higher things; an appreciation of worth; a love of beauty; a demand for ethical living; a realization of a wider range of human interests and activities that mean vastly more in human life than the getting of food, clothing, and shelter. For the human soul, more and more, the struggle for a chance to live becomes the means merely to a fuller, freer, and better living.

Man lives in a given concrete environment. Advancement and appreciation are in exact proportion to the control which he exercises over that environment. Control comes through the adjustment of the individual to his environment, and through the adjustment of environment to the individual. Or, to speak more exactly, control is the adjusting, harmonizing,

and getting command of one's total world of experience. There are not two worlds. One's whole objective world, including the bodily organism, is a projection of certain experiences into space: that is, experience compels each one of us to construct, as it were, a world in space. Just what that world is to each one of us depends absolutely upon what one's experience has been. My world is not your world, nor is yours mine. Yet there is a community of experience, an agreement both in our own successive experiences and in the experiences of different persons, that compels one to accept a certain persistence in existence and a certain regularity in its changes. We posit a world governed by general laws which is not dependent upon thinking, of which world of reality we are a part.

This whole objective world of experience is the world of nature, with its facts and laws and ever-changing complexity. Nature-study in its widest sense takes in all objective phenomena.

## ELEMENTARY SCIENCE

Science is variously defined as "knowledge"; as "comprehension and understanding of truth or facts"; as "that which is known"; and specifically, as "knowledge duly arranged and referred to general truths and principles on which it is founded and from which it is derived." Science, then, according to these definitions, covers the whole range of knowledge. Any field of human thought may be attacked in a scientific way. It is the attitude taken toward subject-matter that makes the procedure scientific. In selecting the title of this report, "Elementary Science," the committee would emphasize the scientific attitude in elementary education. While it has not been the purpose of this committee to investigate all phases of elementary education that should be approached in a scientific way, yet, the committee would have it understood that it would include under elementary science much more than is usually understood by the term "nature-study." The committee is of the opinion that not only so-called natural history, but also the industries, civic activities, social institutions, and any other phase of concrete environment are proper objects of study under elementary science.

The local environment furnishes from the beginning the means essential to the development of the individual. As a matter of convenience in classification, environment is spoken of as being made up of two phases: (1) a so-called nature phase, (2) a so-called social phase. This is an artificial division, since man is as much a product of nature, and his activities are as fully in accord with nature, as any other living organism. This course of study deals with both aspects in so far as these aspects are of a natural and normal nature, in contrast with what are known as purely artificial conditions.

An inspection of our nature environment, in its pure sense, shows it to be made up of:

1. Earth-forming materials and their surface contour.
2. Weather, climate—the atmosphere.

3. Plant life.

4. Animal life.

5. Change, motion, work, energy in the form of (*a*) physical changes; (*b*) chemical changes.

The "social" environment, as distinct from the nature environment, possesses certain characters. Among the most important of these are:

1. Social institutions; as the family, government, church, school, etc.

2. Industrial and commercial activities.

3. Civic activities, etc.

Particularly in the lower grades has this committee felt free to draw upon any field of the child's interests for subject-matter in science.

## GENERAL METHOD

First and primarily, the committee would place itself on record as standing for the scientific attitude in education; for the attitude, on the part of the child, of inquiry, of investigation, of experimentation; for the establishment of facts and principles through such intelligent investigation and the application of the results thus secured by the child to his own problems. This whole point of view conceives education to be a process of growth and organization arising out of the meeting and mastering of actual living problems. The problems which the child is to investigate and solve are those inherent in his own living. The function of the school is to emphasize the more fundamental of these problems, to assist the child in bringing to consciousness the more important ones and to provide him with suitable material and give him intelligent directions in solving them. It is recognized that only as the child himself comes to appreciate his problems and really works out his own solution is he being educated.

The problem of the teacher, then, is largely one of directing the activities of the child. Upon him lies the responsibility of determining largely the sort of problems in which the child shall be engaged, the general method of procedure in solving these problems, and the degree of clearness and efficiency that shall result.

As already indicated, the course of study outlined in this report includes not only what is usually given under nature-study, or natural history, but also much of social and, particularly, industrial activities. Especially in the lower grades is it necessary to include a wide range of activities. Life is a unity. One's activities and interest have their meaning in this life unity. Every act and every thought plays its part in the whole. With younger children the whole range of interests become subject-matter for educational purposes. The work of the school in these earlier years is, largely, the enriching, the orientation, and the organizing of the child's experiences. The only restriction should be that the child's activities are directed along the more fundamental lines of human interests. Certain interests do appeal to every normal child because they are fundamental and universal. As the pupil

advances, his range of interests widens so that it is impossible to take up all lines that might be desirable. It becomes necessary to limit the range of study. The committee believes that the solution here is the selection of a few fundamental typical phases of life and the thorough mastery of them.

Following the outline of the preceding reports, this report discusses elementary science under three general divisions: the primary period, including the kindergarten and the work of the first, second, and third years; the intermediate period, covering the work done in the fourth, fifth, and sixth years; and, finally, the adolescent period, which outlines the work that might be done in the seventh to the tenth years, inclusive. Further, the committee has thought best to suggest the general character of the science work that, in its judgment, ought to be given in the last two years of the high school.

# THE COURSE OF STUDY

## KINDERGARTEN, FIRST, SECOND, AND THIRD GRADES

The following brief outline takes its genesis from the Second Yearbook of the Association and attempts to apply the principles therein outlined to the education of young children. The fundamental idea has been that of initiating a mode of procedure which develops and maintains that unity in the growth process exhibited in the individual child.

Some of the more fundamental "appetences" exhibited up to and including the kindergarten are: (1) acquiring control of the more massive body muscles; (2) functioning of the senses; (3) acquiring a greater or lesser number of stable feelings, or impressions, through sensuous experiences; (4) purposeful activity begins to dominate over impulsive activity; (5) acquirement of a fairly extensive acquaintance with the objects and phenomena of environment; (6) acquiring a fairly extensive noun vocabulary, especially class names.

The child is alive with an active, insatiable curiosity, exhibiting a tendency to pry about, to handle things, to test them out with several or all of his senses, and having sensed them to his satisfaction he casts them aside and goes on to something else. In following him up we find that no object fails to attract his attention, and from all he extracts something which determines his attitude toward each kind of object upon a second meeting. Now, if these sense-acquired materials stimulate organic growth and develop motor control, our procedure should be plain. (To this we may add the need of becoming accustomed and adapted to social co-operation.)

1. Rambles in yards, fields, woods, along shores and streams, on farm and in garden, and countless other places should furnish exercise, sense-experience, motor control.

2. Games, plays, gathering flowers, nuts, berries, building blockhouses, and a mass of other activities should include social assimilation.

3. Meeting real things instead of pictures and artificial things, touching them, handling them, smelling them, tasting them, under proper guidance of a mother or teacher, should give the normal and proper concrete feeling or reaction. To do these things and do them in abundance is the need of the kindergarten. In this generalized condition pupils enter the kindergarten.

### THE KINDERGARTEN

In addition, the instinct of imitation will still be strong, and the more dominant activities carried on by the people of their community, as observed in the home, on the farm, and along the roads and streets, will form nuclei, attracting their attention and stimulating imitation. Certain centralizing ideas, around which may be grouped a considerable range of materials and activities, offer good starting-points for the teacher.

### *The Fall*

The season plays considerable part in these activities, and in the fall the leading idea may be: that as Nature stores up for her rest-time, so must we provide for winter months.

GENERAL TOPICS

I. Nature's storehouses and provisions for winter.
II. Animals' storehouses and provisions for winter.
III. Man's storehouses and preparations for storing.
IV. Utilization of Nature's provisions by man.

*Topic I.* Nature's storehouses and provisions for winter.
- *a*) Seeds and seed coverings (fruits, flowers, weeds, and vegetables).
- *b*) Distribution of seeds.
- *c*) Leaf-buds on trees in relation to falling leaves.
- *d*) Flowers going to sleep and storing up seeds.
- *e*) Tubers, bulbs, etc.

*Topic II.* Animals' storehouses and provisions for winter.
- *a*) Caterpillars.
- *b*) Bees.
- *c*) Squirrels.

*Topic III.* Man's storehouses and preparation for storing.
- *a*) Jars, cans, jelly-glasses, jugs, etc.
- *b*) Barrels, boxes, pantries, barns, cellars.
- *c*) General harvesting.

*Topic IV.* Utilization of Nature's storehouses by man.
- *a*) Preserving of fruits and vegetables.
- *b*) Grinding of grains into flour and meal.
- *c*) Storing of nuts, pop-corn, and fruits.

(The whole accompanied by appropriate exercises, stories, games, and songs.)

### *Winter*

When shut up together so closely in houses the idea of social interdependence may lead, and general topics as indicated may be studied.

I. Home dependences and relationships.
II. Interdependence of the home and those in commercial life who come closest to the child.
III. Dependence and relationships existing between man and Nature.

*Topic I.* Home dependences and relationships.
1. Clothing.
   - *a*) Sewing.
   - *b*) Mending.
   - *c*) Washing and ironing.
2. Food.
   - *a*) Cooking.
   - *b*) Setting the table.
   - *c*) Washing dishes.

3. Shelter.
   *a*) By whom provided.
   *b*) Father's work.
4. Watchful care.
   *a*) By father.
   *b*) By mother.
   *c*) By older sisters, brothers, etc.

This should lead directly to a feeling of dependence and desire on the part of the children to offer some equivalent for the care bestowed upon them. With the co-operation of the parents much real, lasting good may be done in the direction of helpfulness in the home.

*Topic II.* Commercial interdependence.

1. Milkman, our dependence upon him and his dependence upon us and upon the cow.
2. Groceryman upon farmer.
3. Shoemaker and mender upon animal skins.
4. Newspaper-man.
5. Gas-man.
6. Mail-carrier, etc., etc.

Through this thought may be instilled into their minds the whole policy of honest commercial life. These contributors to our welfare receive a just compensation for their kind and helpful service, and our contentment should not be complete until a balance be adjusted between benefits bestowed and received. In all our plays and games play-money may be used and a just compensation for value received insisted upon.

*Topic III.* Relationship to Nature.

1. Clothing.
   *a*) Cotton = cotton plant.
   *b*) Wool = sheep.
   *c*) Leather = skin of different animals.
2. Heat.
   *a*) Coal = mines; freight cars for transportation.
   *b*) Wood = kindling-man; lumber yards; forests.
3. Shelter.
   *a*) Wood = wood-chopper; saw-mill; furniture store.
4. Water and where obtained.
   *a*) Faucets.
   *b*) Hydrants.
   *c*) Lake.
   *d*) Pond.
   *e*) River.
   *f*) Source of water = clouds, sunshine, moisture.
5. Food.
   *a*) Grocer, the medium between us and the farmer.
   *b*) Farmer, the medium between us and nature.
   *c*) Nature and her servants = earth, air, water, and sunshine.
6. Ice, ice-cutting and packing.

*Spring*

The activities accompanying the awakening of spring may be enumerated as follows:

1. Changes that are gradual and temporary.
   *a*) Daily change of clothing to suit weather conditions.
   *b*) Cool mornings and evenings and warm middays.
   *c*) Changes in the weather: sunshine, cool and warm winds, rain, clouds, fogs, dews, frosts, etc.
   *d*) First green spots of grass, places first appearing.
   *e*) Flower beds and garden-making activities—hotbed and indoor box-seedlings.
2. The more gradual and permanent changes in Nature.
   *a*) Changes wrought by the gradually increasing temperature: swelling of buds early spring flowers.
   *b*) Changes wrought by rain.
   *c*) Changes wrought by sunshine.
   *d*) Changes wrought by wind.
   *e*) Changes from bare brown earth and trees to green covering.
   *f*) Return of birds, insects, and other animal life.
3. Changes going on in the schoolroom more or less under the control of children.
   *a*) Seedlings, bulbs, cuttings in window boxes and pots.
   *b*) Changes in frog, salamander, etc., eggs, taking place in aquarium.
   *c*) Changes taking place in cocoons collected in the previous fall.
   *d*) Changes going on with a pair of doves or pigeons, etc., in nest building, incubation, hatching and rearing brood: The whole used to stimulate observations on similar changes and activities out-of-doors.

PRIMARY PERIOD

*Characteristics.*—The general "appetences" of the earlier years are still present and maturing. Curiosity and its accompanying restless activity are still strong, but purposeful activities are beginning to dominate over impulsive activities. Children have acquired considerable ability to do definite bits of work in the form of study, observations, experimentation, making, etc., under the guidance of some simple idea. They are rapidly discovering their ability to do purposeful and useful things, and have a strong personal pride in doing things through their own initiative, and they expect attention from adults in describing or viewing the results. To the extent to which the teacher and the school afford the children opportunity and encouragement in doing independent work, to that extent the children will grow rapidly in power of self-reliance and individual initiative, and free the teacher from details; to the extent that the teacher and the school fail they induce dependence and load themselves with a mass of detail and drudgery.

*First grade.*—In this stage children begin to write short sentences and describe simple experiences; they have acquired considerable power in self-control and are able and anxious to perform a large number of simple activities guided by definite ideas or purposes of their own. Imitation is still strong and a simple suggestion and example may "set them off." In

all, as a matter of economy, they need the guidance of the teacher, but never the dominance. Their daily life brings them into contact with many of the activities performed by people in their daily routine of life, activities pertaining to the house, the farm, the community. Types of work involving considerable action on the part of the children, yielding fairly striking results, and having ahead some definite purpose should be prominent. So far as relates to *learning* we may remain firm in the faith that "the amount of memory drill necessary to insure immediate interpretation is reduced in just the ratio in which practical and immediate contact with impression is increased." Direct handling and doing are the great means of training by which we may obviate the necessity of memory work and drill. The method of learning what things are, their properties, by using them, is so distinctly the modern method of learning that our schools should long since have been putting this type of work into practice, especially in the primary grades.

Activities pertaining to gathering and preserving fruits, gathering and storing seeds, finding out what people collect, prepare, and store away for winter; activities connected with home, farm, and community are rich in their educational possibilities when rightly treated.

The following brief outline relating to the food aspect is intended to illustrate the work involved:

STEPS IN EACH LESSON

1. Orientation—gathering the experiences of the children; what is already known. Formulation of the purpose, or end, if not already definite, and the problems, or difficulties, in the way of its realization.

2. Attempted realization of the end through the overcoming of the difficulties—gathering of material, investigation, experiment, and, finally, if successful, attainment of the end, which is the immediate "application" of the results of such investigation.

3. The wider application of the results to related experiences; some appreciation of the significance of these results in the child's life.

It is assumed that from the beginning the children are working under the direction, but not the dominance, of the teacher; and that the child is acquiring vocabulary, learning to read and to write and to care for the mechanics of expression.

*Lessons:*

1. List of foods eaten every day.
2. Source from which these foods are derived—plant, animal, etc.
3. Uses of foods.
4. Constituents of foods—test for starch with iodine.
5. Application of this knowledge to life—mastication, hygiene.
6. Test for albumens—coagulation.
7. Tests for carbon—burning.
8. Uses of carbon or charcoal.
9. Uses of water.

10. Sources of water. Purification of water—using carbon for filter, distillation.

11. Movements and organs concerned in ourselves and in animals in food getting.

Out of this series of exercises are gathered summaries of the work done, and the results, in the form of elementary composition and reading lessons, of which the following are examples:

LESSON I: What food do you eat every day?
I eat bread and butter.
I eat oatmeal.
I eat potato.
I eat meat.
I eat fruit.
I eat eggs.
I eat salt.
I drink water every day.
What foods do you eat most in summer?
What foods do you eat most in winter?

LESSON II: Where do we get our foods?
Most of it comes from plants.
Bread is made from wheat.
Oatmeal is made from oats.
Potatoes grow on a vine.
Fruits grow on trees and vines.
We get our meat from animals.
Most animals eat plant food.
The cow gives the milk we drink.
What does the cow eat?
The hens lay the eggs.
What do the hens eat?
Where do we get water and salt?

LESSON IV: (Constituents of foods—children write out the results which they obtained through their experiments.)
We had starch.
We put iodine on it.
It turned blue.
Then we put iodine on bread.
It turned blue.
I think there is starch in bread.

ARTHUR CULLUM

We had rice.
We put iodine on it.
It turned blue.
It had starch in it.

VERA MCFARLAND

We found starch in rice, bread, potato, and oatmeal.
They turned blue when we put iodine on them.

CARLTON DODD

LESSON VII: (Introduction to Carbon.)

One day we each had a piece of wood.
It was pine wood.
We tried to change it.
Some of us cut it.
Some of us broke it.
Some painted it.
It was still wood.
Then we burned it.
We saw a yellow flame.
We saw smoke.
We put it into a closed tin box.
There was something else left in the box.
It was black.
It was tasteless.
It would not dissolve in water.
We made an envelope for this black substance.
We put it away.

We burned wood, paper, and sugar.
We got carbon.
It is black.
It will not dissolve.

LUELLA HOPPER

LESSON XI: (Impurities in Water, Uses of Carbon.)

We made a filter.
First we made a funnel of paper.
We put wood carbon in it.
We put quartz sand in it, too.
We filtered red water through it.
We filtered blue water through it.
We filtered muddy water through it.
The filtered water was clear.
We filter water at school.
We filter water at home.

Other topics may be treated in a similar manner, among which may be mentioned:

1. *Clothing:* (*a*) materials used for clothing, (*b*) sources from which these materials are derived, (*c*) steps and stages involved in securing these various materials and working them up into clothing, including gathering of materials, cleaning, spinning, dyeing, weaving, etc., (*d*) investigating the school area to find vegetable materials used for dyeing. The study may include wool, cotton, flax, furs, etc., along with a study of the various things made of each and the "why used" for special purposes.
2. *Animal covering:* materials which various animals have for protecting them and keeping them warm during the winter: (*a*) feathers, (*b*) fur and hair, (*c*) wool, etc. Which warmest? Animals having no covering and how they spend the

winter. How animals change their clothing from summer to winter—shedding, molting, thickened growth of fur, feathers, wool, etc.

3. *Fire making and other ways of keeping warm:* (*a*) various methods by which people make fire, (*b*) various ways or means by which buildings are heated, (*c*) various materials used for heating purposes, (*d*) various uses made of fire and heat other than keeping warm.

*Second grade.*—The children of the second grade should carry farther along uncompleted studies begun in the first grade. We have already noted in the first grade that by following a centralizing idea the work ramifies in all directions beyond what we can follow.

It is essential that we keep our work connected up all through the grades; that we take up the thread of the story in the second grade at the point at which we dropped it in the first grade. This is the stage to initiate nearly all of the fundamental ideas which children will deal with in their work in the succeeding grades. Two aspects of work lend themselves admirably to the needs of the grade: (1) A phase of work connected closely with human needs and human activities initiating the questions of a list of these needs and the way we meet them, and how other people meet them; (2) In passing to and fro children will meet many objects and phenomena and note many changes due to natural forces, as contrasted with changes induced by people.

Under the first type, as children in the first grade became familiar with foods used and some of their properties, so children in the second grade may investigate the methods by which people secure and prepare foods for use. The class names, as flour, fruits, meats, etc., become centers for investigation and study.

The following outline on the study of flour is a type of the successive steps that may be developed in the study of foods:

1. Collecting children's experiences on things used in making flour.

2. An examination of various flours, their physical differences, and the kind of bread made from each.

3. An examination of the bread-making constituents of flour. The constituents necessary to make real bread.

4. Making flour: (*a*) methods of crushing the grain until it is reduced to flour, (*b*) various ways people (especially primitive) ground their grains, (*c*) ways in which we make flour today.

5. Visit to flour mill, in which children trace out the processes through which the wheat passes from the time it enters the mill until stored in flour sacks and shipped; cleaning grain, scouring, breaks, sifting. Grades of flours, by-products, and uses made of them.

6. The chief bread-making grains of various countries and peoples; those using mostly rice, barley, rye, corn, wheat, millet, etc.

Similarly, the work of the first grade should be continued in a fuller investigation of the elementary processes involved in:

1. The making of clothing and textiles in general: (*a*) materials from which we get fibers—grass fibers, bark fibers, split wool fiber, bast fiber, cotton fiber, etc. Why we cannot spin all fibers, as hair, milkweed "cotton," etc.

2. The erection of shelter: (*a*) houses of various peoples, especially of primitive peoples as Esquimaux, Indians, Tree-Dwellers, etc., to our modern dwellings and their plan of construction.

NOTE.—The first part may have been started in first grade.

3. Methods of cooking: (*a*) making an out-door camp fire and cooking things according to primitive methods; cooking utensils; fireplaces to stoves and the evolution of the stove.

4. Methods of heating: (*a*) disadvantage, inconvenience, of camp fires in tent or cave, advantage of fireplace, advantage of stove, and evolution of heating of dwellings.

5. Lighting: (*a*) needs of lights, first lamps, disadvantage of burning brand, choice of pine knots, made fagots, and the elementary story of the evolution of lighting.

The full range selected for study should include all the more important primary individual needs of the race and should result in the children acquiring a fairly definite notion of man's dependence upon environment.

This, along with their native interests, should aid us in the next step: that of aiding children to take into account their own casual daily experiences, accumulating them, and seeing what they may get out of them.

A simple scheme, such as below, may aid the child in these first beginnings to observe and to record observations of interest and significance.

MONTH: OCTOBER

| Day | Date | Character of the Day | Observations |
|---|---|---|---|
| Monday..... | 3 | Cool, clear, n.w. wind, 52°. | Elm tree leaves beginning to fall. Oak tree leaves green. Flocks of sparrows in vacant lots. |
| Tuesday..... | 4 | Warm, hazy, s.w. wind, 67°. | Made painting showing landscape. Found caterpillar spinning cocoon. |

A couple of weeks' or a month's accumulation of data will yield material for a considerable range of problems, such as: significance of "elm leaves falling," of "caterpillar spinning a cocoon," etc., and a listing of observations indicating methods of preparing for winter: (1) list of ways in which animals prepare for winter; (2) list of ways, as observed, in which plants prepare for winter; (3) list of ways, as observed, in which people prepare for winter; (4) ways in which seeds are distributed.

In classifying and grouping these experiences there will always be a residue which will not group; observations of little worth, recorded, will, however, help the child to understand what gives an observation value. These same experiences may be summarized into a picture of the month.

OCTOBER

This is October.
The air is cool.
The sky is blue and clear.
There is frost in the morning.

The grass is brownish-green.
The leaves and nuts are falling.
We gather the aster seeds.
We gather the goldenrod seeds.
The wind gathers many seeds, too.
The maple leaves are yellow and red.
The oak leaves are brown and green.
The elm leaves are yellow.
The ash-leaf maple tree is bare.
We see the birds flying south.
We find the cocoons of the caterpillars.
We find the cocoons of the spiders.
We cannot find the caterpillars.
We cannot find the grasshoppers.
We cannot find the ants and earthworms.
Where are they?

If this work is adequately carried out, in range and quality, the children should, by the end of the year, have acquired a goodly number of definite ideas with reference to their environment and of man's relation to it and dependence upon it. They have also acquired ability to write, spell, experiment, observe, and work under direction. They should now be ready to take the greater mass of their minor and isolated experiences and group them around some fairly comprehensive idea or problem which would utilize all of their past experiences and make demand for a large range of additional experience. In this a study of the relation of the people of their local community with reference to the total activities carried on in that community, and of the way people came to settle in that region, affords opportunity for the type of study demanded by the grade. In a region like Chicago the history of its development is an excellent correlating center.

*Third grade.*—A study of the development of Chicago, as a type. The work of the fall is made up largely of various trips to different type areas with a view to gaining some familiarity with the physiographic character of the area. These type areas consist in the main of: (1) lake shore; (2) the sand-dune area; (3) the ridge-swamp area; (4) the flat plain; (5) the river valley and border; (6) the upland moraine, etc. Typical portions of these types are visited and examined with a view to determining: (1) the physical and scenic character of the area (painting or sketch usually made); (2) the character of mineral and soil materials found in each area; (3) the plant life common to the area; (4) the animal life common to the area; (5) uses, past and present, which man makes of the area.

On these trips data of the nature listed below are collected:

TRIP TO LAKE SHORE

1. Appearance of the country (see sketches made by class).
2. Location of area south end of Lake Michigan. (See Miller's Station on map of Chicago area.)

3. Mineral and soils. (See collection marked "Lake Shore at Miller's.")

4. Plant life.

| Name | Place Found Growing | Characteristics of the Plant, Stem, Roots, Foliage, Fruit, etc. | Influence on Area, Uses to Animal, Man, etc. |
|---|---|---|---|
| Sea-rocket... | On barren sand along beach and on dunes. | Low, oval, branching stalk with fleshy foliage. | A pioneer soil maker, hold sand, foliage used as greens. |
| Sand-cherry.. | Abundant along beach and along margins of dunes. | Low, five feet, spreading shrub of cherry type. | Fruit eaten by man and animals. |

5. Animal life.

| [Name | Place in Which Seen and Place It Makes Its Home | How It Lives and Food It Feeds Upon | Influences upon the Area and Uses to Man |
|---|---|---|---|
| Muskrat.... | Along Long Lake and swamps, lives in water. | Burrows in the earth, builds houses of mud and reeds, eats roots, clams. | Destroys plants, digs holes in earth, fur and flesh used by man. |

6. Ways in which man is making use of the area: (1) use made of land in way of crop raising; (2) use made of area as residences; (3) use made of any natural products: (*a*) of sand, gravel, etc., (*b*) of clay, of limestone.

7. Uses made of the area, in the past, as evidenced by the Indian remains found: (1) conditions attracting Indians: (*a*) wild life that inhabited lake, swamps, thickets, and prairie, (*b*) Indian life in relation to this original environment.

8. The coming of the white man and the story of the development of Chicago. In this Nature and man get so closely connected that science, industry, and history fuse. Old inhabitants are questioned, old books consulted, and every effort made to piece out the story of man in his relations to the region and how the region developed. The following extract from work of children will give some idea as to the tone and trend of the study.

"If you had been in Chicago years ago you would have seen many swamps on the South Side. A man lived here in 1830 and wrote to his friend telling him how the hunting was, and this is a portion of the letter: 'Vast quantities of water fowl were feeding on wild rice, seeds, and insects in the swamps. Swan, geese, brant, passing to and fro, kept up an incessant cackling. . . . . There were ducks of every kind, from the mallard and canvasback down to the tiny water witch and blue-winged teal, while hundreds of gulls hovered gracefully over the swamp.'"—L. L.

"Tall reeds, rushes, cattails, wild rice, and water lilies grow in the swamp. You will find dragonflies and fish and frogs there, too. The yellow-headed blackbird, and the red-winged blackbird are swamp birds which feed on the wild rice."—E. B.

"Wild rice grew on the banks of the Chicago River. The Indian squaws would go out and gather it in years gone by. They would paddle along in their canoes. When they came to a big patch they would bend the rice stalks over their canoes and beat them. They had a big mat on the bottom. They would empty the rice into a big basket. They gathered until their baskets were full. They used the rice for food."—E. W.

"The life and comfort of the Indians depended upon their skill and success in hunting. They needed the skins for clothing, for the wigwams, and the meat for food. The Indian had to learn the habits of animals in order to catch them."—F. Mc.

In this way they enter more and more into details in working out, with reference both to the present and to the past, man's intimate relations with and dependence upon his environment. In following up the idea of man's acquiring familiarity and control of environment they come to see how in early days man went out after the things which he needed, but that in later and present days he sits in his home, and things from the ends of the earth are brought to him, and the idea of the great importance of co-operative industry and commercial relations begins to acquire significance.

## THE INTERMEDIATE PERIOD

During the primary period the child has been interested in the facts and activities of the world about him mainly as facts and activities. His questions have been "What is it?" "What is it for?" and the replies to these questions have enabled him to orient himself to a greater or less degree. This attitude toward a new object is maintained through life, but other interests are added. The child of the intermediate period is not satisfied with knowing what an object is and what it is for; he goes a step farther and asks the question, "How does it work?" The world to him is not static. Results are accomplished through changing processes. He desires to get control over these processes. He wants to "make it work." This seems to point out what phases of Nature appeal most to the child of this period and the line to be followed in furthering his education. He is interested in how Nature supplies his needs and the needs of his home, and this interest widens so as to include the world. The course of study in science, then, should include the dynamic phases of Nature as it administers to human needs: a study of how the necessities of life are met. But Nature appeals to him in other ways than as merely supplying the necessities of life. His heart leaps up when he beholds the rainbow in the sky. Nature arouses his aesthetic instincts. Properly approached, the water-fowl, the chambered nautilus, the river, the mountain, and the waterfall become more to him than merely the means of supplying food, shelter, and clothing. They arouse and satisfy his aesthetic and spiritual instincts, and any study of Nature which does not carry the pupil through to a realization of these is falling short of its possibilities. But to the intermediate child, the utilitarian side of Nature appeals most strongly; and through a study of this phase he comes to a consciousness of the more refined aspects.

A careful study of the so-called "nature-study" movements in the nineteenth century reveals the fact that in almost every instance where a course of study in elementary science as science has been formulated, it has resulted in a formal study of science from a scientist's standpoint. Subject-matter in itself has become the basis of the course, and this subject-matter has been treated from an adult standpoint and more or less isolated from the mental attitude and interests of the child. It is thought best in this period not to differentiate science into separate subjects. In his study of the world about him as it ministers to his needs, he finds Nature is constantly at hand. The facts of bacteriology, physiography, geography, geology, astronomy, chemistry, physics, physiology, zoölogy, botany, entomology, domestic science, meteorology, mineralogy, and the whole round of sciences appear, but not in a differentiated form. They are applied sciences, but have not yet been precipitated and thought of as sciences. It may be desirable, and necessary at times, to devote a separate period to following up some phase of science that

has come into the field in connection with some problem in the study of human needs. For instance, in the study of coal, a class may desire to give attention to the geologic ages related to coal formation, but not for the sake of studying geology. The primary problem is a different one. The period of differentiated science comes later, and it may be said that the school must see to it that attention be given later to gathering up the science material collected during the primary and intermediate grades into the form of organized groups, or into "the sciences."

TOPICS FOR STUDY

General Topic: Our needs.

What is needed every day in order to carry on life? How does your family supply these needs; that is, what is the occupation of your father?

Three methods of supplying: by physical labor, by mental labor, by mental and physical labor together.

A. Interests from the standpoint of physical needs.

I. A study of food interests.

Make a list of the foods used by your family. Which of them grow wild? Which were produced by yourselves? Which were produced in your locality? Which were produced in other parts of the world? Where were supplies not produced by the family secured?

*a*) People who collect and distribute our food.

1. The grocery.
   Experiment: Visit the grocery.
   Observe kinds of food found there, how they are wrapped or packed, methods of keeping clean, care to prevent waste, where secured, nature of the grocer's work from day to day, how he makes life more comfortable for us.
2. The meat market.
   Experiment: Visit the meat market.
   Observe kind of foods found there, how arranged in store. Safeguards against impurities, care to prevent waste, where supplies are secured, nature of owner's work from day to day, different cuts of meat, what makes some cuts more valuable than others, how the meat market is a convenience for us.
3. The bakery.
   Experiment: Visit a bakery. Study in a similar way.
4. The dairy.
   Experiment: Visit a dairy.

Note that the study of the source of food supply leads back to the farmer, the truck gardener, the fruit grower, and the fisherman.

*b*) The people who produce our food.

1. The farmer.
   Experiment: Visit a farm.
   Note the buildings and implements required, farm plants, farm animals, the work of the farmer from day to day and from season to season, how the farmer makes life more comfortable for us.
   Farm plants.
   *aa*) Corn.

Experiment: Plant corn at different depths in the school garden. Note results. What kind grows the best corn? kinds of corn, what kind of an ear is best, corn judging, elements in soil that produce best ear, kind that produces stalk, simple soil testing, part of the plant used for food, cross-fertilization, how the farmer plants, cultivates, and harvests his corn, different uses of the different parts of the plant, fodder, silo, ear and shelled corn, what he does with the surplus, food elements of corn, corn starch, corn oil, corn rubber.

Experiments: Test corn for starch; test corn for oil; pound up grains and bake the meal; visit mill where corn is ground; visit grain elevator, note how corn is dumped, shelled, put into cars.

Food value of corn and corn products.

Changes in the corn plant through cultivation.

Experiment: Visit Field Columbian Museum and note specimens of corn in a more primitive state.

Visit a field before husking time, note tassels with grains, note other irregularities which indicate a partial reversion to type.

The corn belt of Illinois: Where located, kind of soil, how soil was made, cities of corn belt, market for corn, Chicago. Make a map to show corn belt, cities, and lines of transportation.

Corn belt of United States. Chart.

Corn belts of the world. Chart.

Historical: The Indian of the prairie, and the corn plant, the coming of the pioneer to the prairie, route of coming, method of transportation, what he found, method of reducing the sod, oxen and horses, the buffalo, prairie fire, where early settlements were located, as along the streams, needs that gave the schoolhouse, the village with its store, blacksmith and wagon shop, orchards, roads, and bridges. The French in Illinois.

Study other corn areas of the world, make map to show principal cities, rivers, canals, and railroads. Account for location of principal cities.

*bb*) Wheat studied in same way.

*cc*) Other grains of the farm.

*dd*) Other plant products of the farm.

SORGHUM

One day in May our teacher gave us some cane seeds to plant. The seeds were of a reddish-brown color and of an oval shape.

My father had the ground plowed and I took the rake and tried to rake out the lumps. Then he took the hoe and made a furrow across the garden, in which we dropped the seeds. Then we covered them with soil.

Sometimes I took a sprinkler and watered the ground where they had been planted. One day when I was out in the garden I saw some little green sprouts. It was the sorghum seed. It looked very much like grass only its leaves were broader.

The stalks grew to be from fifteen to sixteen feet high. They were jointed like corn, but the leaves were longer. The flowers were of a yellowish-green and bloomed in August. After the flowers disappeared the seeds could be seen. They grew in a cluster.

The first of October my father took a long corn knife and cut it down. He cut it near the ground because there is more juice in the bottom of the stalk. Then we stripped off the blades, cut off the tops, tied the stalks into a large bundle and took it to the schoolhouse.

One day all the pupils of our schoolroom went over to the laboratory of the high school. The boys had a clotheswringer to squeeze the juice out of the stalks, and a tub to catch the juice. We put the sorghum through the wringer twice to get all the juice. It had little pieces of stalk in it, which we strained out. Then we put the juice over the Bunsen burner.

It took it about three and one-half hours to boil down to syrup. As the impurities rose to the top they were skimmed off. The syrup was a reddish-brown color and we had about a pint and it tasted better than what we get in the store.

C. R., 5th Grade

Farm animals:

Experiment: Visit a farm.

Note the different farm animals, how the farmer cares for each, food of each, use the farmer makes of each, the benefit we get from them.

*aa*) The cattle industry.

Beef cattle: How cattle are fattened on the farm, how shipped to market, care in transit, corn-fed cattle and ranch-fed cattle, states where each method prevails, beef-producing states, make map to show beef-producing states and lines of transportation, which use corn-fed method, which use ranch-fed method, great stockyard cities, value of stockyards.

Experiment: Visit Union Stock Yards. Note area, method of handling cattle, follow through to cooling-room, how beef is marketed, use of refrigerators, care to preserve cleanliness, by-products, as hides, hair, gelatine, glue, oleo-oil, butterine, combs, buttons, knife-blades, jet trimming, fertilizers.

Ranch life, size of herds, methods of identifying, the round-up, early methods of marketing beef in the western states, why changed, why stockyards are built farther west.

Value of beef product in the United States, to what countries exported, nations which compete with the United States, locate them by making chart.

Kinds of beef cattle.

Historical.

John C. Fremont, Lewis and Clarke, Zebulon Pike, The Old Santa Fé Trail, The Oregon Trail.

Dairy Cattle.

Experiment: Secure milk, place in different places and let cream rise, note why it rises, where it rises the best, skim cream, churn sweet cream, let cream sour and churn, where the butter appears, prepare butter for the table.

HOW WE MADE BUTTER

We bought two quart bottles of milk and a half-gallon bucketful. We put one bottle in the furnace room and we put the other bottle and the crock out on the fire escape. We let them stand until the next morning and found cream on the top. We let the cream stay on one bottle and took it off the other bottle in the furnace room and from the milk in the crock. The bottle in the basement did not have as much cream as the bottle out-doors. We put some of the sweet cream in a bottle and shook it hard for sixty-four minutes but it foamed and we could not get any butter, so we left the rest of the cream until the next day and shook it up good and got some butter in about eighteen minutes. Hildur said the butter would be sour, but it wasn't. Our teacher said the butter fat was wrapped up in little skins and the sour

bacteria made the skins weak so when we shook it we let the butter out. The boys liked the buttermilk. B. M., 4th Grade

Experiment: Visit a dairy farm.

Note arrangement of barn, feed suited to milch cattle, methods of handling and disposing of milk and cream, cream separator, precautions to insure cleanliness.

Experiment: Visit creamery.

Note testing of cream, means of removing impurities, churning, working and salting of butter, care of vessels and other precautions to insure cleanliness, methods of keeping fresh, preparations for market.

Make a map of the dairy section of the United States, why each section is devoted to dairying, difference in milk production in poor and high-grade cows, amount a good cow will produce, kinds of milch cattle, how cheese is made, milk-sugar, condensed milk, special methods of producing butter and cheese in Norway, Switzerland, and Holland, form in which butter is usually shipped to market, use of refrigerator cars, value of butter and cheese produced in the United States, what nations compete with us, locate other dairying nations and cities.

*bb*) The horse studied in the same way.

*cc*) The hog studied in the same way.

*dd*) Other farm animals.

*ee*) The poultry industry.

2. The truck gardener.

Experiment: Visit a truck farm.

Note the kinds of vegetables and berries he grows, equipment in way of hotbeds and labor-saving machines, nature of his work from day to day and season to season, how he makes life more comfortable for us.

*aa*) Cabbage.

Experiment: Plant cabbage seeds in different soils and note results.

Experiment: Make hotbed and grow plants, set out in school garden, cultivate, and market. Part of cabbage used for food, value as a food, how prepared for shipment, how served.

*bb*) Other products of the truck gardener.

The changes brought about through cultivation. The work of Mr. Burbank.

3. The fruit-grower.

The kinds of fruit grown in orchards—grapes, berries, apples, cherries, pears, peaches, oranges, grape fruit, figs, apricots.

Those grown in temperate regions, those in subtropical regions.

*aa*) The apple—the typical temperate climate fruit.

Experiment: Visit an apple orchard, note nature of trees, kinds of apples, season of ripening, how sorted and prepared for market.

Uses of apples: raw, cider, preserves, canned.

Part of plant used for food.

Time required for an apple orchard to come to bearing, insect enemies and friends, how enemies are held in check and friends encour-

aged, the grafting and budding of trees, rejuvenation of old orchards, the irrigated orchards of the West, orchards of Michigan and influence of Lake Michigan. Make map showing orchard sections, principal cities, etc.

Experiment: Visit Land Show at the Coliseum. Changes that have taken place under cultivation.

*bb*) Other fruit products of temperate climate. Make map.

*cc*) The orange, typical subtropical fruit.

*dd*) Other subtropical fruit.

Chart fruit areas, fruits as foods, methods of preserving: cold storage, drying, canning, preserving.

Experiments: Can peaches; dry apples; make preserves; the making of fruit butters and marmalade; a study of molds and ferments.

4. The fisherman.

What kinds of fish are found in your river; how caught; what kinds are best for food?

The equipment and work of the fisherman.

*aa*) The cod.

Study life-history and habits of the cod, regions frequented, how secured, uses made of it, how prepared for market. Make map.

*bb*) Other fish studied in same way.

*cc*) Oysters and other mollusks.

How does the fisherman make life more comfortable for us?

*c*) Water as related to food interests.

1. Directly.

Necessity for water on the part of plants and animals, where we get our water supply, ground water, wells.

Experiment: Collect soils of different natures, place in deep jar and pour some water over it. Note the kinds of soils that permit water to pass through most readily, which hold moisure longer. Study origin of springs, geysers, wells, cisterns, how water becomes purified, ways in which water may become contaminated, what finally becomes of ground water, how the farmer holds moisture in the ground, dry-farming.

Experiment: Visit the city water-plant, how the water is lifted, and how conveyed to homes.

2. As indirectly related to foods.

Sources of water, rain, snow.

Evaporation:

Experiment: Put water in different sized open vessels. What becomes of it? Does size of vessel have any relation to rapidity of evaporation? Does temperature? Wind? Other instances of evaporation.

Precipitation:

Pitcher of cold water on a warm day. What causes "sweating"? Other instances. Cause of precipitation: clouds, rain, frost, snow, sleet, hail, dew. The fair-weather cloud, the rain cloud, the storm cloud, the rainy areas. Make a chart. How are evaporation and precipitation of value in the production of food?

Running water:

Experiment: Notice the water that falls on the school yard during a rain. Note water partings, slopes, streams, pirating, meanders, wearing bank, building bank, oxbows, rapids, falls, the leveling work of a stream, how a river system is built up, how running water helps the people who produce our food.

*d*) Soil as related to food production.

Experiment: Examine different kinds of soil under the magnifier. What is found, how soil is formed, notice indication of weathering in various places, notice different soils as to color, fineness, sandy or gravelly, clay or loam, where blackest, why. Test for humus.

*e*) Air as related to food production.

What plants and animals get from the air.

Experiments: Set a glass bell over a growing plant and watch results.

Experiment: Note feeling of lassitude when impure air is breathed for some time.

Air as it helps in evaporation and precipitation.

*f*) The use of foods.

Necessity of foods, how our bodies take up food through assimilation. Mastication and insalivation, digestion, assimilation, care of the teeth, need for different kinds of food elements, nutrients found in different foods, dietetics, effect of heat upon food materials.

II. A study of shelter interests.

Kinds of houses as to materials used, homes of primitive and arrested peoples.

*a*) People who contribute to the building of homes.

1. The carpenter, nature of work, tools used.

Experiment: Visit a house in process of building. Note kinds of lumber used, size of pieces, rough and dressed, difference in materials as to finish and durability.

Experiment: Work with different woods in shop, note difference in resistance. How the carpenter makes life more comfortable for us.

2. The mason. Studied in the same way.

MAKING CEMENT BLOCKS

We learned to make concrete blocks for building parts of Athens to illustrate our history work.

We had to have moulds so we found old boxes and boards down in the school workroom and made them. The moulds were three feet or more in length. We planed all the boards down till they were about a half-inch thick and very smooth. We put the boxes together with four-penny, wire finishing nails. When the moulds were done, the inside measurements were two inches wide, one inch deep. Then we measured on the side spaces one inch apart and sawed them across to the bottom board. While we were making the moulds, some of us boys were experimenting with the concrete. We tried two weeks before it satisfied us and these are the proportions: 1 qt. cement, 1 qt. sand, 1½ qts. crushed stone, very fine.

We sifted the sand and the crushed stone, and the more we sifted it the better concrete it made. We mixed it thoroughly while it was dry and then put water in it till it was thin enough to put in the mould. After it stayed an hour or two, we cut it with a sharp, thin knife into blocks. Next day we tipped out the blocks, which were soft, but grow harder every day.

P. P., 5th Grade

3. The plumber. Studied in the same way.
4. The electrician. Studied in the same way.
5. The painter and decorator. Studied in the same way.

*b*) Processes for making home more convenient, i.e., the mechanics of operating the home.

1. Light in the home.
Primitive methods of lighting: kerosene, mechanics of the kerosene lamp, source of kerosene supply. Gas as a luminant, natural and manufactured gas.
Experiment: Secure coal and clay pipe and make gas. Electric lights, simple principles of generating electricity by experiment in the laboratory.
Experiment: Visit the city power-house.
Gasoline and acetylene as illuminants.
Experiment: Visit a building where these are used and study method of operating. Danger in the use of each kind of illuminant.

2. Heat in the home.
Primitive and pioneer methods of heating.
Kinds of material used for heating homes.
*aa*) Coal.
Study the two varieties, hard and soft coal, separately. How is each supposed to have been produced? Note difference. Location of hard coal and of soft coal mines of the United States, of Great Britain, of France, of Germany, of Austria, of Russia. The coal supply of other nations of the world. Number of square miles of hard coal regions in the United States. Coal mines are opened either by sinking a shaft to the vein, by tunneling to the vein horizontally, or, when the vein appears on the surface, by opening it. Method of mining hard coal. Life of the miner. His average weekly wages. The breaker boy. The door tender. The miner's helper. Use of the "breakers." Thickness of a vein of coal in the hard coal region. Depth to which the hard coal mines are sunk. Important uses of coal. How coal is taken to market. When owners of coal mines are also part owners of railroads that convey the coal to market, what harm may come? Square miles of soft coal regions in the United States. Annual value of soft coal product in the United States. Does the United States export coal, what kind and to what nations? Will this continue? Does the United States import coal and, if so, from what place and why? The relation of coal to manufacturing. Is the coal product of the United States likely to be soon exhausted? How is this in England? In France? Consumption of coal rapidly increasing. Reason. Burning smoke. Improvements in the methods of combustion and steam production. When was coal first used to any great extent in the United States? Make map to show coal areas.
Experiment: Visit a coal mine. Note shaft, provision for ventilating, process of mining, coal props, danger of mining, how coal is elevated, means of lighting.
Experiment: Fill bowl of clay pipe with pieces of "soft coal." Seal bowl with wet clay and fasten stem in clamp on ring stand. Heat bowl of pipe in Bunsen flame persistently for 15 minutes. When

stream of smoke is seen issuing from stem. hold burning match to it. Result. This is illuminating gas. Let pipe cool, then break and examine contents of bowl. What is it? What by-product causes shiny appearance of parts of it? Is this process used in commerical preparation of the gas and by-products? What other method is also used?

Make map to show coal areas of the world.

*bb*) Other materials used for heating homes, studied in detail.

*cc*) Heating systems, fireplaces, stoves, hot air, hot water, steam, gas. The mechanics of heating studied by actual observation.

3. The water supply in the home. Mechanics of water supply. Precaution against impurities.
4. Sewage disposal. Methods in detail.
5. Rooms in the home, uses and arrangements of rooms to secure a maximum of comfort with a minimum of effort.
6. Principles of home decoration.

*c*) Materials used in the building of homes.

1. The lumber industry, lumber areas, a lumber camp, floating the logs to mill, the saw mill, plane and quarter sawed, the planing mill.
   Experiment: Visit planing mill.
2. Stone as a building material.
   Experiment: Visit a quarry. Study in detail. Kinds of stone and characteristics of each.
3. The brick and tile industry.

III. A study of clothing interests.

Clothing of primitive peoples. Where we get our clothing.

*a*) People who supply us with clothing.

The period of home manufacture, period of machine manufacture.

1. The dry goods and clothing store, kinds of cloth, arrangement of wares, nature of the work of the store-keeper, where he gets his supplies. How he makes life more comfortable for us.
2. The tailor.
3. The dressmaker.
4. The milliner.
5. The shoe store.

*b*) Materials used for clothing.

1. Wool.
   Experiment: Secure a fleece of wool, wash, comb, dye, spin, and weave; the sheep industry, areas of wool growing, the great woolen mills.
   Experiment: Visit a woolen mill. Note processes used. Methods of dyeing, materials used in dyeing.

OUR FLEECE OF WOOL

A few days ago we went down to the sheep sheds. While we were down there we bought a fleece of wool. It weighed 6 pounds and cost us 40 cents a pound. It was dirty and greasy, so we had to wash it out. It took us a long time to get it clean. Each one of us had a wad of it to wash. Some tried cold water and no soap, some tried warm water without soap, and some used soap and warm water. It was quite a job to find the best way to clean our wool. It was bad about getting knotted up into little balls, but when we got good soap and used

hot soft water we got along all right. We borrowed some combs from some old ladies who used to make their own blankets, and combed it out as straight as we could. We looked at some under the magnifier and found that the wool hairs are rough and have little hooks on them. That is what makes the wool stick together. We tried spinning it into threads and found it was quite a job to do it like they used to by whirling a stick, but we got some yarn. We asked an old Swedish woman to come up and spin for us. We borrowed a spinning wheel and she came up and used it for us. She could work very fast and we tried it some, but we were too clumsy. We are trying to find out how to color our yarn now so it won't fade; but we haven't found a good way yet.

A. M., 5th Grade

2. Cotton.
3. Silk.
4. Flax.

OUR FLAX

Last May we thought we would raise some flax, so we got a pound of seed down at the drug store, and each one of us took home some to plant in our gardens. We had to ask a good many before we found how to plant it. Some of us thought it ought to be planted in hills, and some thought it ought to be planted in rows, and some thought it ought to be set out like tomato plants, but we found that it ought to be sowed like oats and raked over. Mine was a little slow about coming up and I thought it was weeds at first. I had to pull the grass and weeds out of it two or three times. It blossomed late in the summer. The flower was small and purple and the stems were about two feet high. After school commenced we began to talk about when we would harvest it. We read in a book that about three-fourths of the blossoms ought to be dead, so in October we cut it. Some of the children pulled theirs up by the roots, but I guess it is better to cut it close to the ground. We began studying how to get anything to weave. We tried breaking some of it up but could not get any threads. We put some out on the grass and left it for three weeks in the dew and rain, then brought it in and dried it. We found then that when we broke up the straw we could get the fibers. The part that is used for thread is under the bark and next to the wooly part of the stem. We found in the *Scientific American* how to make a flax brake and we boys made three in the shop. After we got it broken up we found it coarse, so made a hatchel out of a board and some nails. We combed the flax with this until we got the coarse stuff out of it. This coarse part is called tow and is used for stuffing couches and chairs. We made some threads of the finer part, but it was not very good. Our teacher got Mrs. L. to come up with her flax wheel and spin some thread for us. We borrowed some hand looms from the second grade and tried weaving. We are wanting to go down to Aurora and visit the cotton mills there and see how they do the work of spinning and weaving by machinery.

H. B., 5th Grade

5. Hemp.
6. Leather.
7. Rubber.
8. Other materials.

IV. Miscellaneous subjects not already treated. Tobacco, opium, medicinal herbs, beverages, condiments, gold, silver, lead, and other minerals.

If the study of each of the foregoing subjects has been carried out in detail, as intended, the child will have considerable knowledge of the facts of botany, zoölogy, physiology, geology, physics, chemistry, bacteriology, mineralogy, climatology, but not organized as science. It is thought that toward the close of the period he is ready to organize some of this into form as science, and earth science is taken as the first.

In his study of the source of the materials which satisfy his primal needs, he has visited every quarter of the globe and should have become familiar with

the general facts of geography. He may now organize this knowledge into scientific form; he may take up earth science more as science and get the "why" of his facts, and the relation of these facts to each other and to human life in a more general way. The following outline is intended to view the facts from a somewhat different standpoint and to get them in a more organized form.

V. General Geography.

*a*) Globe studies, form of the earth, size, rotation, revolution, gravitation, day and night, changes of seasons, latitude, longitude, zones of temperature from the standpoint of latitude, atmospheric circulation due to unequal heating, origin of winds, zones of wind and belts of calm, causes for rain, altitude and climate, the ocean and ocean currents.
Make chart to show meridians, parallels of latitude, zones.
Make map to show wind belts.
Make map to show ocean currents.

SUGGESTED PROBLEMS AND EXERCISES

1. Locate the great mountain systems in each of the grand divisions of the earth.

2. Locate for January the northwest trade winds, the southeast trade winds, the three great belts of calms, the two belts of westerly winds, the Arctic and Antarctic winds.

3. Locate each of the chief ocean currents for December, as Gulf stream, Japanese current, Labrador current, etc.

4. Locate the same for July.

5. Draw the winter isotherm of 66° in the northern hemisphere and account for all the great bends in it.

6. Account for the heavy rainfall of the Amazon and Congo valleys.

7. Account for the following desert regions: Sahara, Persia, Gobi, interior of Australia, Utah.

8. Source of rainfall in Mississippi Valley. On the Atlantic slope.

9. Note the latitude of Montreal and of Venice and account for the difference of climate.

10. Suppose the Rocky Mountain system obliterated, how would it affect the climate of North America? Would it help United States if a mountain range extended along its northern boundary?

11. Suppose the Alps extended north from the Adriatic Sea to the Baltic. What changes in climate of Europe east of that line? West of that line?

12. Account for the frequent failure of the India wheat crop.

13. Why is the Orinoco Valley arid during a part of the year and drenched with rain at other times?

14. Where do most of the commercial rivers of Europe rise? Account for this.

15. Why has Spain less rainfall than France?

16. How is a vast amount of the vapor and heat of the equatorial regions transported to the temperate regions? Good of this?

17. Effect of large lakes and inland seas upon climate? Which shore of Lake Michigan is most affected? of Black Sea? of Mediterranean? Gulf of Mexico?

18. How do rivers determine the location of cities?

19. Explain the formation of rain, hail, snow, dew, frost.

20. Explain land and sea breezes.

*b*) Continental studies.

1. North America, with special reference to the United States.

*aa*) As a continent.

1. Location and relative size—extreme latitudes and longitudes, comparative latitudes, area compared with other continents, area as compared with land area of the earth, direction and distance from other continents.
2. Surface features—mountain areas, highlands, lowlands, the drainage basins, coast features.
3. Climate—tropical climate, inter-tropical climate, regions of constant rains, regions of rainy summers and dry winters, rainfall in the path of the trades, prevailing westerlies, mountain barriers in the path of the westerlies, temperate regions, frigid areas.
4. Life—effect upon vegetation, animal life, and man, of latitude, altitude, relief, climate, and all physiographic features. The ice areas, tundras, forest areas, grassy plains, agricultural areas, desert areas; vegetation of these areas; wild life on land and in water. Peoples, wild and civilized, and their characteristics, occupations, dress, habits of life, social institutions, distribution of population, etc.
5. Social organization—Dominion of Canada, United States, Mexico, Central American States, government of each. Subdivisions of United States. Principal cities.

*bb*) Divisions of the continent.

1. The Mississippi Valley—location and size, surface, climate, life, industry and commerce.
2. The great plateaus and the Pacific slope.
3. The Appalachian region.
4. Canada.
5. The Gulf coast.
6. Mexico and Central America.

2. Europe.
   Studied first as a continent, then a study of local areas.
3. Asia.
4. Africa.
5. South America.

*c*) Study of world belts.

BELT OF 10° N. TO 10° S. AROUND THE WORLD

1. On outline map of the world trace the boundary lines of this belt. Name important countries of South America, of Africa, of East India Islands. Fill places on map as needed.

2. Prevailing winds in America, in Africa, in East Indies. Account for these winds. Which of the three sections has the most desirable climate? Why?

3. Compare, as to products and inhabitants and commercial use, the Amazon Valley and Congo Valley.

4. North and south of the forest regions found in answering No. 3 are treeless plains. Locate them, learn their names, and the reason for such plains.

5. Why is the climate of the islands of this belt so different from that of America and Africa in the same belt?

6. What are the important products of the islands in this belt? Three cities.

7. Account for great differences in the climate of the eastern and western coasts of South America in this belt. Name two cities on or near each coast.

8. What commercial products found on the Congo River? What does this valley promise for future development? Locate a city on each coast of Africa.

9. How is the Nile River dependent on what happens in this belt?

BELT 10° N. TO 30° N. AROUND THE WORLD

1. On outline map of the world, trace the boundary lines of this belt. Name important countries included in America, in Africa, in Asia. Fill in all places called for below when needed.

2. Prevailing winds in America, in Africa, in Western Asia (summer winds and winter winds separately), Eastern Asia (summer and winter separately). Account for these winds.

3. Note the location of the highlands in relation to the prevailing winds and then tell about the rainfall in the different sections of this belt. (Three greatest desert regions and three regions of heavy rainfall.)

4. Locate cities of two hundred thousand or more: in America two, in Africa none, in Western Asia none, in British India eight, East India five. Reason for such a grouping of cities.

5. Character of the people compared with people of United States.

6. Compare temperature of different sections with that of City of Mexico or Manila. Account for contrasts.

7. What are important industries of the different sections?

8. What important nations are interested in the belt? Where is greatest progress now indicated?

9. What part of this section was in the Indies sought by Columbus? Would it be thought worth the effort today?

10. About what part of the population of the earth is in this belt and in what part of the belt? Is this belt a good one to live in? Reason. What races of men in this belt?

BELT OF 30° N. TO 50° N. AROUND THE WORLD

1. On outline map of the world trace the boundary lines of this belt. Name important countries in America, Europe, Africa, Western Asia, Eastern Asia. Fill in places called for below as needed.

2. Prevailing winds in America, in Europe, in Africa, in Western Asia (in summer, in winter), in Eastern Asia (in summer, in winter). Account for these winds.

3. Note the location of the highlands in relation to the prevailing winds and then account for the rainfall in the different sections of this belt.

4. What important cities of United States in this section?

5. Note the desert and semi-arid regions of this belt, locate the northeast trade winds, and then account for the lack of rainfall in the different sections. Why the cities in Eastern Asia?

6. Give the great products of this belt. In the fertile regions, is it easy or difficult to raise these products? Is this good or bad for the people? Races found in this belt?

7. The great crops of United States grown in this belt? In what part is each produced?

8. About what part of the area of the United States in this belt?

9. Are the products you discovered in answering No. 8 largely manufactured in this region? Reason.

BELT NORTH OF 50° N.

1. Name important countries in this belt in America, in Europe, in Asia. Locate places on outline map of the world as needed.

2. Prevailing winds in winter and in summer in Southern Canada, in Southwestern Canada east of the Rocky Mountains, in British Columbia, in Alaska.

3. Locate the forest regions of America, of Siberia. Note the semi-arid region south of the forests of Siberia and explain why no such belt exists in America (Great Lakes and Gulf of Mexico).

4. Why is the influence of the Atlantic Ocean not large on the climate of Siberia? What prevents the Pacific Ocean from modifying the climate of most of Canada? Influence of Hudson Bay on Canada. Which has greater promise for the future, Canada or Siberia?

5. Locate the great river valleys in this belt. Compare, as to both area and usefulness, these rivers with those of the belt south of this. Reasons for your conclusions.

6. Contrast the climate of North America in this belt with that of Europe. Account for the difference. What section of North America (of Asia) has a climate similar to this belt of Europe south of 60° N.?

7. Locate all the large cities of this belt.

8. In the European section of this belt, excluding Norway, Sweden, and Russia, there are about two hundred million people. Compare with Texas, with California, with Brazil, with south half of China, as to value commercially, educationally, religiously.

(Belts of southern hemisphere studied in a similar way.)

VI. Commerical Geography.

Throughout this entire course, and especially in the study of food, clothing, and shelter interests, more or less attention is given to commercial activities. It is thought advisable, however, before taking up "physiography" to devote some time to a special study of commercial activities.

*a*) A review of the great agricultural areas; why they are such areas; what sort of products are grown in each; where each of these products are shipped (such as are not consumed at home); why people who receive such products do not grow them; principal collecting and distributing centers; what determines the location of such centers; chief routes of travel and why; methods of transportation and why.

*b*) A review of the chief mining areas; why so located; chief cities in each; what determines location; influence of such life on a people; methods of distribution; routes of travel, etc.

*c*) A review of the chief manufacturing centers; why given to manufacturing; influence of life on people; where products are sent and why; distribution; routes; etc.

*d*) A study of the development of transportation — steamship, railway; building of canals, harbors, terminals, tunnels, etc.

B. Science from the standpoint of aesthetic and general interests.

Space forbids a detailed outline of work in this phase of science, but such a treatment seems unnecessary here. With such excellent suggestions as are given by Holtz in his "Nature-Study" and by Hodge in "Nature-Study and Life" a mere suggestion here to show the recognition given by the committee to this phase of science seems sufficient.

I. Animal study.

*a*) Domestic animals and pets, a study of habits of these animals with such study of their structure as will explain their habits; care of these animals.

*b*) Wild animals.

1. Which have not disappeared with the coming of man, as the squirrel, the mink, chipmunk, birds, reptiles, insects, mollusks, coral, sponge, etc.
2. Big game.

The moose, bears, lions, wolves, seals, whales, the eagle, etc.

Note adaptation to climate and surroundings, protective coloration, food, methods of securing food, means of defense, means of attack, life habits. Some notice of classification. Protection and preservation of useful and interesting animals.

II. Bird-study.

The common birds studied out-of-doors in their native haunts: "a bowing acquaintance with the birds that nest in our gardens, or under the very eaves of our houses; that haunt our woodpiles; keep our fruit-trees free from slugs; waken us with their song, and enliven our walks along the roadside and through the woods." Attempt made to give the children a naturalist's point of view rather than that of the scientist.

A study of habits of birds such as mating, nesting, migration, manner of migration; calls, notes, coloration. Protection and preservation of birds, Audubon societies, Bird Day, methods of attracting birds.

III. Plant-study.

Germination of seeds, plant organs of the higher types of plants, names and characteristics of our common trees, care of tree, tree surgery, forest reserves, underground stems, buds, leaves, movements, distribution of plants, seed dispersal, Arbor Day.

## THE ADOLESCENT PERIOD

It is the belief of the committee that probably the most marked mental attitude accompanying the dawn of adolescence is an intensification of the child's interests in what may be termed the "world of adult activities" surrounding him. Moreover, it is believed that there are valid reasons, both psychological and practical, for the segregation of the sexes for their science work during at least a portion of this period. These beliefs are the justification of the committee for providing courses in household science for the girls during a part of the period and of courses in various phases of industrial science for the boys.

Some attempt has been made in the outlines that follow to provide a logical arrangement of topics. It should be understood, however, that it is not the thought of the committee that the order provided here must be strictly followed. Indeed, every topic should be approached, not as a topic in science, or in some particular branch of science, but as a vital problem in the life of the child; as an obstacle which comes between him and the rational mastery of his environment, the realization of his "larger self."

Again, while it is undoubtedly true that in the earlier high-school period we may venture somewhat farther from the child's immediate environment in our choice of topics, yet this only means that the "larger self" has come to include a greater portion of the world than formerly. The outlook has become broader and the child has appropriated the problems of, it may be, far distant peoples. We should remember, however, that it is still the real problem of real people that holds the attention and it is the thought of the committee that every topic studied should be approached with this fact clearly in view.

### Outline of a Course in Physiography for Last Half of the Seventh Grade

In this course as in all the other courses outlined in this report, it is the thought of the committee that the work should be accompanied at every step by, indeed should largely consist of, field studies and laboratory illustration and demonstration. No textbook nor teacher can take the place of actual observation.

A. The atmosphere.
   - I. General conception.
   - II. Constitution.
   - III. The weather.
     - *a*) Careful and extended observations.
     - *b*) The factors of the weather.
       1. Temperature.
       2. Winds.
       3. Humidity.

*c*) An experimental study of weather observation instruments.
1. The thermometer.
*aa*) Experimental study of effects of heat.
2. The barometer.
*aa*) An extended study of air pressure and its effects.
*bb*) Barometric changes due to convection currents.
(1) Experimental study of convection currents.
3. The hygrometer.
*aa*) Studies in evaporation and accompanying heat effects.
*bb*) Full study of atmospheric moisture.
(1) Clouds, fogs, dew, frost, and the various precipitations.

*d*) The general storm, or "low" or "cyclone."
1. Its origin.
2. Its characteristics.
3. Why it brings stormy weather.

*e*) An analysis of a large number of popular weather "signs" to determine whether or not they have scientific bases.

*f*) Weather maps and weather forecasting.

IV. Climate.
*a*) The various influences which affect it.

V. The work of the atmosphere.
*a*) Mechanical.
*b*) Chemical.

B. The hydrosphere.
I. The ocean studied as a whole.
*a*) Sea-water.
1. Its temperature in different localities.
2. Its movements.
*aa*) Waves.
*bb*) Tides.
*cc*) Currents.

*b*) Life in the ocean.

*c*) The work of the ocean.

C. The lithosphere.
I. A more intensive study of the following topics.
*a*) Relief features.
*b*) Ground water.
*c*) Running water.
*d*) Snow and ice.
*e*) Lakes and shores.
*f*) Vulcanism.
*g*) Crustal movements.

D. Influence of earth forms and features upon human life.
I. Rivers.
*a*) As highways for migration and trade.
*b*) As boundaries—ethnic and political.

II. Plains.
  *a*) Small and surrounded by barriers.
  *b*) Large and no barriers.
  *c*) Watered or arid.

III. Piedmont region.

IV. Mountains.
  *a*) As barriers.
  *b*) As habitations.
  *c*) Influence upon climate.

V. Islands.
  *a*) Continental and oceanic.
  *b*) As stepping-stones.
  *c*) As cradles.

VI. Oceans.
  *a*) As highways.
  *b*) As barriers.
  *c*) As sources of wealth.

VII. The coast—accessible from land and sea.
  *a*) Zone.
  *b*) Harbors.
  *c*) Contrast of coast and inland peoples.

### Course in Household Science for Girls, Eighth Year

The aim of this course is to make stronger, more perfect, more vigorous bodies, to decrease the number of attacks of preventable disease, to live more economically in regard to both money and energy, and at the same time to increase health and happiness; also to show that the manner of our living is not a haphazard affair nor regulated by tradition, but is based on scientific principles which are immutable.

Further, the course should arouse such an interest in the affairs of personal and household routine that they shall cease to be dull drudgery but shall appear, rather, as alive, as other, less commonplace, problems which require training and skill and are yet not so important for a healthy body and an efficient life.

To serve these purposes, the topics selected for study have been grouped about: A, the care of the individual; B, the care of the house; C, the care of the community.

This course, which is largely devoted to the more general principles, presupposes at least one year's work in cooking and one in sewing in the lower grades. In the absence of this, progress is slower, more application being necessary. And, to accomplish the best results, it should be accompanied by a thorough course in the actual preparation of food by way of application of the principles here worked out.

This course in the eighth or ninth grade will require an average of forty-five minutes per day in recitation and an equivalent period for preparation.

On three days of each week the two periods, recitation and study, should be combined and spent with the teacher in the laboratory.

The applications embodied in the course in cooking may be given on the two-period days, the recitation work being done on the one-period days and as it is called for by the subject-matter on laboratory days.

A. Needs of the individual.

I. Food.

*a*) To preserve it for future use.

Experiment I: To discover what makes food spoil.

*Method:*—Leave

1. Hard, smooth-skinned, whole fruit,
2. Hard fruit with broken skin,
3. Fruit with rough skin (orange, lemon),
4. Soft fruit with firm skin,
5. Tomato (acid),
6. Berries,
7. Fruits wrapped in paper,
8. Other foods, bread, eggs, meat, etc.,

in places where the following conditions may be investigated:

1. In barrel, box or basket, not separated.
2. Separated.
3. Temperature of 45 degrees. Refrigerator.
4. Temperature 75 to 85 degrees. Room.
5. Packed in sawdust, dry, clean sand, chaff.
6. Cool air, light, natural humidity.

Form conclusions as to:

1. What causes spoiling? (Molds)
2. Where does it come from?
3. Its growth as affected by:
   *a*) Texture of fruit and skin.
   *b*) Quiet air, darkness, contact.
   *c*) Acidity.
   *d*) Temperature.
   *e*) Moisture.

Experiment II: To discover how molds injure foods.

*Method:*—

1. Study individual mold plants under the microscope.
   *a*) Parts. Function of each.
   *b*) Different kinds of molds.
2. Plant molds on fruit syrups and watch growth of all parts.
3. Smell molded food. Taste syrups prepared in (2).
4. Remove mold and boil. Effect on taste.

Experiment III: To preserve food from molds.

1. By drying.
   *a*) Method of cutting.
   *b*) Other conditions.

2. By heating to 180 degrees F. (temperature recommended for grape juice).
3. By heating to the boiling point.

Experiment IV: To determine the effects of yeasts upon fruit.

*Method:*—

1. Allow apple juice to stand for several days exposed to the air.
2. Put part of a yeast cake into apple juice and let stand. Compare results with (1). Examine under the microscope.
3. Boil some fruit juice from (2) after one day and leave open. Compare with the rest of (2) after several days.
4. Boil and seal.

Experiment V: To determine the effect of different temperatures upon the growth of yeast.

*Method:*—In fermentation tubes prepare solutions of sugar, add yeast, and keep at:

1. 125 degrees F.
2. 70 to 90 degrees F.
3. Use yeast which has been frozen before adding to the sugar solution.

NOTE.—Compare the rapidity of the evolution of gas in the various cases.

Experiment VI: To apply knowledge acquired in study of yeast:

1. To the making of bread.
2. To the keeping of yeast.
3. To fermented jelly, etc.

Experiment VII: To determine the cause of the spoiling of meat, milk, eggs, cereals, etc., and vegetables, not acid.

*Method:*—

1. Put samples into test tubes in water. Notice of decay—gas bubbles, odor. Compare odor with that resulting from mold and yeast activity. Is this caused by molds? Yeasts? Examine with microscope. See bacteria.

Experiment VIII: To determine methods for preserving foods from bacteria.

*Method:*—

1. Compare drying (Exp. III).
2. Antiseptics. Syrups, brine, spices, alcohol, vinegar, oils, each on appropriate foods.
3. Freeze once, seal, place in 70 to 80 degrees.
4. Boil samples for one minute, 5 min., 30 min. each, and seal.

Experiment IX: Application of heat to preserve fruit and vegetables indefinitely.

*Method:*—Work out from preceding experiments:

1. Advantages of three ways of canning.
2. Intermittent sterilization.

(Can fruits, vegetables, and make jelly.)

*b*) To preserve the wholesomeness of food for present use.

Experiment X: Bacteria in water.

1. Sources of water supply and chances of contamination.
2. Significance of bacteria in water.
3. Methods of purifying.
4. Methods of controlling contamination.

Experiment XI: Bacteria in milk.

1. Lactic acid bacteria. Make litmus tests.
   *a*) Effects of temperatures: 50, 70, 90 degrees F.
   *b*) Effects of pasteurizing by heating to 165 F. and cooling to 49 degrees, immediately.
   *c*) Effect of heating to 165 degrees and maintaining that temperature 20 minutes.
   *d*) Effect of boiling 1 min., 5 min., 30 min.
2. Other bacteria.
   *a*) Source.
   *b*) Effect on man.
   *c*) Effect of heat and freezing.
   *d*) What is good milk:
   As to chemical composition.
   As to bacterial contamination.

Experiment XII: Harmful organisms in meat.

1. Bacteria.
   *a*) Kinds.
   *b*) Sources.
   *c*) Effect upon meat.
   *d*) Effect upon person eating the meat.
   *e*) How made harmless.
2. Parasites.
   *a*) Kinds and sources.
   *b*) Signs of.
   *c*) Effects upon person.
   *d*) How killed.

*c*) To make the food more palatable and nutritious.

NOTE.—The amplification of this topic is given in the accompanying outline on cooking. A laboratory and equipment are needed for it.

The preceding topics have been treated fully enough to suggest the method of treatment throughout. There follows a series of topics more briefly outlined. The same general experimental method of treatment should be observed in studying them.

The study of the bacterial contamination of foods studied in the preceding topics will lead to the following:

Experiment XIII: Sewage disposal.

1. Dangers from sewage.
2. Public and private methods of disposal.

Experiment XIV: Garbage and manure.

1. Dangers from.
2. Care to be taken of.
3. Disposal of.

Experiment XV: Flies and other insects.
1. Haunts.
2. Carrying ability.
   *a*) The feet.
   *b*) In their bodies. Tuberculosis bacilli in specks.

II. The freedom of the individual from disease.
*a*) A diseased individual as a spreader of disease.
1. Cause of an infectious disease.
2. Elimination of bacteria.
   *aa*) Mouth, nose, skin, eyes, genito-urinary tract.
3. Care of excretions to avoid possibility of their reaching another person while virile.
4. Disinfection of excretions.
5. Care of bedding, wash basins, bath tubs, toilets, drinking-cups, eating-utensils, handkerchiefs, soap, towels, combs, books (wetting fingers to turn leaves), etc.
6. Careless habits of breathing, coughing, talking, sneezing, kissing, playing halloween games, etc.

*b*) How an individual may take bacteria into the body.
1. By way of the mouth.
   *aa*) In food and drink.
      (1) How foods stuffs may become contaminated.
         Place where grown.
         Diseased animals.
         People handling them.
         Dust, flies, other insects.
         Persons in kitchen.
         Persons at table.
   *bb*) Fingers, pencils, handkerchiefs.
   *cc*) The nose.
      (1) Inhaled with dust.
   *dd*) The eyes.
   *ee*) Through the skin.
      (1) Through cuts or abrasions.
      (2) Rubbed through.
2. Precautions to prevent entrance of bacteria to body.

III. Personal hygiene.
*a*) Under this topic there should be presented enough biology to enable the children clearly to understand the meaning of a cell, a nerve, a muscle, a blood vessel, etc. There should be a study of plant and animal cells with a comparison of their structures and functions. There should also be given enough of the physiology of the digestive, circulatory, respiratory, excretory, muscular, and nervous systems to enable children to understand their hygiene.

*b*) The body's defenses against the multiplication of bacteria.
1. Air.
2. Food. Proper kinds and amounts, properly eaten.
3. Exercise.

4. Not over-fatigue. Study effects of work on muscles.
5. Not over-exposure. To extremes of hot and cold.
6. Increased number of leucocytes.

*c*) Elementary dietetics.
1. Comparative calorie values of different foods.
2. Simple dietetic principles and practices.

*d*) Emergencies.
1. Fainting, cuts, drowning, burns.

B. The care of the house.

I. Bacteriology and chemistry of:
*a*) Sweeping and dusting. (Also physical problems—settling.)
*b*) Scrubbing, laundering, dishwashing.
1. Soaps, washing powders, bluing, removal of spots and stains.
*c*) Cooking.
1. Use of fuels. Amounts necessary to produce definite results.
2. Comparison of different fuels.
3. Building a fire.
4. Conductivity of media.
*d*) Principles of artificial cooling.
*e*) Applications of the principles of cooking to the cooking of simple foods. This should both illustrate the principles of cooking and give skill in cooking all kinds of nutrients and food stuffs.
*f*) Lighting—natural and artificial.
*g*) Plumbing—the mechanism and care of.
*h*) Heating and ventilation.

C. The care of the community.

I. This will consist largely of a summary of previous work showing:
*a*) Individual's responsibility for welfare of the community.
*b*) Government's control of conditions affecting the welfare of the individual.

### The Course in Cooking

This course is to supply application in the household for the principles in the general science course for girls.

A. Heat and its use.

I. Temperature to be obtained in using water to conduct heat, and the phenomena observed in bringing it to a boiling point (applied to cooking fresh fruits).
II. Conditions affecting evaporation (applied to dried fruits).
Cooling and freezing mixtures (applied to frozen dishes).
III. Conductivity of materials (freezers and fireless cookers).

B. Nutrients in foods.

I. Carbohydrates.
*a*) Sugars. Syrups and candies.
*b*) Starch. Corn starch.
*c*) Vegetables and fruits.
*d*) Cereals.
*e*) Flour.

1. Rôle of gluten in flour.
2. Leavening agents.
   *aa*) Physical.
   *bb*) Chemical.
   *cc*) Yeast.

(Applied to batters and doughs.)

II. Fats.
   *a*) Conductivity.
   *b*) Burning point.
   *c*) Emulsions.

(Use in frying, salad dressings.)

III. Proteins.
   *a*) Milk.
      1. Chemical composition.
      2. Effect of temperature.

(Cheese, junket pudding.)

   *b*) Eggs.
      1. Composition.
      2. Temperature.

(Eggs and custard.)

   *c*) Meat.
      1. Structure.
      2. Composition.
      3. Effect of temperature.
      4. Selection.

(Emphasis on use of cheap cuts.)

C. Planning and serving meals with reference to cost and balanced ration.

NOTE.—This is accompanied by elementary dietetics in the science course.

SEWING. NINTH YEAR

The work of the second year is designed to supply:

A. A knowledge of the fabrics used in making cloths and of their manufacture into textiles to promote intelligent selection and buying of cloths.
   I. The tests for different fibers.

B. The principles of design as applied to color and form:
   I. In dress.
   II. In wearing the hair, etc.

C. Selection of materials with reference to their conductivity and hygroscopic qualities.
   I. Method of dressing with regard to conductivity.
      *a*) Purpose, money available, wearing qualities, etc.
      *b*) Thick layers as compared with a greater number of thinner layers holding air spaces.

D. Preparation of cloth for garments and care of cloth.
   I. Shrinking.
   II. Setting of colors.
   III. Removal of spots and stains.
   IV. Effects of washing chemicals and heating upon fibers and color.

E. The making of garments (underwear, waists, dresses).
   I. Principles of patterns, cutting, fitting, and sewing.

F. Calculation of cost of individual garments; also of outfits for girls of different environments and of different financial ability.

The last six weeks of the second year should be spent in a recapitulation of the principles involved in supplying the individual needs and in the care of the house and the community. Follow this with:

A. The evolution of the "shelter" into a "home."
   I. The primitive shelter. The purpose it served.
   II. Tribal, or group, shelter.
      *a*) Its disadvantages.
      *b*) Its advantages.
   III. The desire for better conditions for the working out of individual ideas led to a house apart for an individual and his companion, i.e., his wife.

B. Relations of husband and wife.
   I. What excites admiration.
      *a*) Physical, moral, and mental qualities.

C. Effects of various physical and moral conditions upon the home.
   I. Continuation of happiness.
   II. Health of husband and wife.
   III. Ability to hold the respect of the community.
   IV. Chance to do some share of the world's work.

D. Effect of these conditions upon children.
   I. Heredity.
      *a*) Reproduction.
      *b*) Inherited qualities—physical, mental, moral.
   II. Environment. Its influence.

E. The object of a home as ideally conceived.
   I. Preparation for making a home.
   II. The responsibility in undertaking to make a home.
   III. The ability to maintain a home.

### A Year's Work in Agriculture. Eighth Grade

The order of the following topics is determined by the assumption that the study will be taken up in the fall, September 1, and continued through the year.

It seems impracticable to make this outline either a textbook in agriculture or a laboratory manual. An attempt is made to suggest a series of topics suitable for attack by eighth-grade children, where the environment is of such a character as to warrant it. The importance of making the studies concrete at every step, of persistently studying things instead of "about" them, of laboratory illustration and investigation wherever possible cannot be too much emphasized.

A. The selection and storage of seed corn.
   I. Principles and rules governing the selection.
      *a*) Height of ear, angle, maturity, etc.

II. Characteristics of different varieties of corn.
  *a*) Three or four varieties raised in the neighborhood.
III. Corn judging.
  *a*) Rules of Illinois Corn Growers' Association.
  *b*) Use of the score card.
IV. Principles governing the storage of seed corn.
  *a*) Conditions of temperature and moisture.

B. Harvesting and storing the summer and fall crops.
  I. The cereals.
    *a*) Wheat, oats, corn.
      1. The machinery employed in harvesting and threshing, comparing with those of earlier days.
  II. Vegetables.
    *a*) Potatoes, cabbage, turnips, etc.
  III. Fruits.
    *a*) Peaches, pears, apples, etc.
  IV. Roughage for stock.
    *a*) Hay.
      1. Timothy.
      2. The clovers, alfalfa.
      3. Other legumes.
    *b*) Straw.
    *c*) Corn fodder.
    *d*) Ensilage.
      1. Construction and principle of the silo.

C. A study of fall weeds.
  I. Identify several varieties by leaf, stem, and seed.
    *a*) Cocklebur, butter print, mustard, etc.
    *b*) Make collections of seeds, place in bottles, and label.
  II. Provisions made for the survival of these weeds.
  III. Methods of eradicating.

D. The fall birds.
  I. Particularly the seed-eaters.
  Habits of feeding.
  Migration.

E. A study of farm animals.
  I. Characteristics and history of a few common breeds of:
    *a*) Horses.
      1. Draft horses.
      2. Roadsters.
        *aa*) Compare types of these two.
    *b*) Cattle.
      1. Beef cattle.
        *aa*) Two or three of the most common breeds.
        *bb*) A study of stock dietaries.
        *cc*) Plan balanced rations for beef cattle.

2. Dairy cattle.
   *aa*) The commonest breeds.
   *bb*) Compare with beef breeds.
   *cc*) Plan balanced ration for dairy cattle.

II. Detailed computations of the profits from stock.
   *a*) Profits from a work horse.
   *b*) Profits from breeding horses for sale.
   *c*) Profits in beef production.
   *d*) Profits from dairy cattle.

III. Similarly study sheep, hogs, poultry.

F. Make a more particular study of milk and butter.

I. Dairy methods to insure cleanliness.

II. Pasteurization and care of milk. Bacteria, etc.

III. Testing milk for butter fat.

IV. The cream separator.

G. Fall and winter phases of tree life.

I. Identification of trees in winter garb.

II. The cutting of trees.
   *a*) For lumber—poles, posts, boards, timbers, etc.
   *b*) For wood, i.e., firewood.

III. Compute the profit to the farmer of a "wood lot."
   *a*) How it can be had.
   *b*) Trees suitable to make quick growth.

H. A more extended study of general forestry.

I. Uses of forests.
   *a*) Firewood and lumber, as above.
   *b*) Conservation of moisture.
   *c*) Play spots for the people. Parks, reservations, etc.

II. Individual species of forest trees.
   *a*) Hard wood trees—oak, elm, walnut, etc.
      1. Uses, habitat, present supply and value, time required to reach maturity.
   *b*) Soft wood trees—the pines, etc.
      1. Same topics as above.

III. Conservation of forests.
   *a*) The government forest service.

K. The testing of seed corn.

I. The importance.
   *a*) Compute yield of an acre, having hills 3 ft. 8 in. apart each way, each yielding three 12-ounce ears.

II. Study the conditions necessary.
   *a*) Heat, moisture, air.

III. Study, also, the germination of other seeds.
   *a*) Better results will be obtained with large seeds.

L. Study and practice other methods of propagating plants.
  I. Make root grafts of apple trees.
  II. Make cuttings of willows or Carolina poplar.

M. An experimental study of the growth of plants.
  I. Effects of heat, light, moisture, gravity, etc.
  II. The significance of "leaf green."

N. Laboratory study of soil physics.
  I. Formation and physical composition of soils.
  II. Classification of soils according to texture.
  III. Moisture relations of soils. Experimental.
    *a*) As to percolation.
    *b*) As to capillarity.
    *c*) As to capacity for moisture.
    *d*) Moisture content as affected by tillage.
  IV. Physical effects of humus in the soil.
  V. Soil temperature as affected by color and drainage.
  VI. Improvement of physical condition of clays by addition of lime.

O. The experimental plot.
  I. Arrangement of the plot for experimental purposes.
    *a*) Plan a system of crop rotation and divide the plot in harmony with the plan.
  II. Studies in cultivation.
  III. Studies of fertilizers.
  IV. Preparation of the soil.
    *a*) Purposes.
      1. To render root penetration easy.
      2. To conserve moisture.
      3. To promote aeration.
  V. The planting of the plots.
  VI. The cultivation.
    *a*) To eradicate weeds.
    *b*) To conserve moisture.
    *c*) To promote aeration.
  VII. Animals as related to the experimental work.
    *a*) Earthworms and the soil.
    *b*) Gophers, mice, etc., in relation to the crop.
    *c*) Insect enemies of field and garden.
    *d*) Toads, frogs, etc., in relation to insects.
    *e*) Birds.
      1. Insect eaters.
      2. Weed-seed eaters.
      3. Vermin eaters.
  VIII. The weeds that bother and how to exterminate them.

R. Planting of trees and shrubs.
  I. Forest trees.
  II. Fruit trees.
    *a*) Pruning and care.
  III. Fruit-bearing shrubs.
    *a*) Currants, gooseberries, etc.
  IV. Ornamental shrubs.

INDUSTRIAL SCIENCE. EIGHTH OR NINTH YEAR

The committee suggests for the work of the boys during the eighth and ninth years a series of topics in industrial science. The course in Agriculture outlined for the eighth year can be used where the interests are agricultural. In other communities, the community industries will largely suggest the character of the work. The following topics are suggested as suitable:

1. The elements of metallurgy.
2. Petroleum and its products.
3. Illuminating gas.
   Natural gas, coal gas, water gas.
   Study the coal-tar products in connection.
4. The lumber industry.
5. The meat-packing industry.
   Study soap-making industry.
6. Motive power.
   Animal, steam, electricity, gas, wind, water, etc.
7. Heating, lighting, plumbing of houses.

To suggest somewhat more definitely the possibilities implied in these topics, the committee has outlined the subtopics which may be studied in connection with one or two of them.

THE ELEMENTS OF METALLURGY: IRON

A. Get from the children a long list of the commercial forms of iron.
  I. Nails, pipes, tools, stoves, bolts, rods, castings, etc., etc. Extend this list until it is a *long* one.
  II. Have the children, from their general information, classify these forms into cast iron, wrought iron, and steel.
  III. Name the properties of these various forms and from these suggest the differences among cast iron, wrought iron, steel.

B. Study the properties of cast iron, wrought iron, and steel to be able to distinguish among them.
  I. Test samples of cast iron, wrought iron, and steel for:
    *a*) Malleability.
    *b*) Elasticity.
    *c*) Flexibility.
    *d*) Brittleness.
    *e*) Hardness.
  II. Name the uses of these various forms of iron as determined by their properties.
    *a*) Which kind likely to be used for the following, and why?
      1. Nails, stoves, water pipes, steam radiators, wagon tires, fence wire,

piano wire, springs, structural iron, cutting tools, railroad rails, iron roofing.

C. The manufacture of the different kinds of iron.
  I. Visit a blast furnace, if possible, and study the reduction of iron ore.
    *a*) Study the construction of a blast furnace.
      1. Why called blast furnace?
    *b*) The charge.
      1. The iron ore itself.
        *aa*) Probably an oxide. Ferric oxide. $Fe_2O_3$.
      2. The reducing agent and fuel.
        *aa*) Some form of carbon—coke or coal.
      3. The "flux."
        *aa*) Limestone or sand.
          (1) Dependent upon impurities in the ore.
    *c*) The process.
    *d*) The products.
      1. Cast iron—pig iron.
        *aa*) White cast iron.
          (1) Carbon largely in combination.
        *bb*) Gray cast iron.
          (1) Carbon largely crystallized out. Graphite.
  II. The chemistry of the reduction.
    *a*) What determines the character of the flux used?
    *b*) The fusion of the flux with the impurities to form "slag."
    *c*) The reduction of the iron oxide. Formations of the oxides of carbon.
      1. Illustrate in laboratory with the reduction of cupric oxide.
    *d*) Some carbon will inevitably be taken up by the iron.
      1. 2% to 5% the carbon content of cast iron.
    *e*) Properties of cast iron.
      1. Brittle.
      2. Cannot be welded nor tempered.
      3. Strong, however, and durable if not subjected to shock.
  III. Study the history of iron-ore reduction.
  IV. Trace our ores to their sources.
  V. The making of steel.
    *a*) Made from cast iron.
      1. By burning out part of the carbon.
        *aa*) The open-hearth process.
        *bb*) The Bessemer process.
        *cc*) Crucible steel.
    *b*) Properties of steel.
      1. Hard.
      2. Elastic.
      3. Can be tempered.
  VI. Wrought iron.
    *a*) The puddling furnace.
    *b*) Rolling mills.
    *c*) Properties of wrought iron.

Having studied the metallurgy of iron, the metallurgy of other common metals can be taken up, it being only necessary to point out the differences among the processes. Several of the metals are combined with sulphur, in the form of sulphides, to form the ores. This is particularly true of zinc, lead, and mercury. The general rule is: Ores other than oxides are first roasted to change them to oxides. Then the process is very similar to that employed for the reduction of iron. Mercury, however, is an exception to the rule.

Again, in some cases there are valuable by-products. Thus, sulphuric acid is a valuable by-product of the zinc industry.

Aluminum will introduce the interesting processes of electrolysis.

The use of the "cyanide" process in the metallurgy of gold makes "pay dirt" of great masses of tailings formerly discarded.

Eight or ten common metals should be selected, their commercial forms listed, a study made of the location of the mines from which they come, the reduction of their ores investigated, and their properties and uses learned. A brief history of each will add interest to the work.

In addition, a considerable amount of actual work with the metals in the manual-training course accompanying this course would give far greater value to the knowledge sought in these lessons.

### Lighting and Heating of Dwellings

Note.—A book entitled *The Elements of Physical Science*, written and published by F. D. Barber, Normal, Illinois, contains a great deal of valuable information along the lines suggested by these topics.

A. The lighting of houses.
- I. History of fire—the first flame.
- II. Primitive lamps.
  - *a*) The pine knot.
  - *b*) Greek and Roman lamps.
  - *c*) Present lamps of the Esquimaux.
- III. Candles.
  - *a*) The burning of a candle.
- IV. Kerosene lamps.
  - *a*) A study of petroleum and its products.
    1. Distillation. Fractional distillation.
- V. Gasoline. Its properties and uses.
  - *a*) Gasoline lamps.
  - *b*) Gasoline gas machines.
- VI. Illuminating gas.
  - *a*) The coal gas industry.
- VII. Acetylene gas.
- VIII. Electric lighting.
  - *a*) Incandescent lamps.
  - *b*) Arc lamps.

B. The heating of houses.
- I. The historical aspect.

*a*) The open fireplace.
*b*) The first stoves.
II. The burning of wood and coal.
*a*) The chemistry of combustion.
1. The chemistry of the air.
*b*) The common heating-stove.
III. Kinds and compositions of common fuels.
IV. A study of furnaces.
*a*) Convection currents.
1. In water.
2. In air.
*b*) Drafts of chimneys.
*c*) Hot-air furnaces.
*d*) Hot-water furnaces.
*e*) Steam furnaces.
V. The open grate.
*a*) Importance in ventilation.
VI. Cooking-stoves and ranges.
*a*) Approach from the historical point of view.
*b*) Gasoline and gas stoves.
1. The manufacture of coal gas.
*c*) The fireless cooker.
1. The question of conductivity.
2. Questions of specific heat.

### Physiology and Hygiene. Tenth Year

In this as in the other courses it has not seemed practicable in every case to give details of experimental work. In so far as possible every principle taught should be rendered objective by laboratory illustration and demonstration.

A. The normal function of the human body.
I. Activity—the doing of useful work.
*a*) Physical work—muscular activity.
*b*) Mental work—nervous activity.
1. Both result in fatigue and final collapse, unless:
2. The store of energy be replenished in some way.

B. A study of "the cell" as the unit of structure of plant and animal tissues to give better understanding of the effects of activity.
I. A typical cell illustrated by California grape.
*a*) Wall.
*b*) Protoplasm.
*c*) Nucleus.
II. Study of cells.
*a*) In some tissues all of the same shape.
1. Skin of onion.
*b*) In some cases they show a variety of shapes.
1. Epidermis of lily—guard cells.
*c*) Some cells have special function as to product.
1. Starch cells of potato.

*d*) Plant and animal cells essentially alike.
1. Compare cells of onion skin with epithelial cells of the mouth.

III. Functions of cells.
*a*) Some cells able to do all the things any plant or animal can do.
1. Illustrated by pleurococcus and paramoecium.
*b*) As evolution progresses cells become highly specialized.
1. Nerve cells, muscle cells, fat cells, etc.

IV. Activity of the organs results in the breakdown of these cells.
*a*) The consequent necessity of replenishment.

C. Food. The new material necessary to promote cell growth and maintain the efficiency of the organs for activity.

I. Protoplasm, basic factor of cell composition, composed of:
*a*) Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus.
1. Chemical study of these elements.
2. Study of their various compounds.
*aa*) Properties of the elements and of their compounds dissimilar.
(1) Compare hydrogen or oxygen with water.
(2) Compare carbon (charcoal) with butter.
(3) Compare nitrogen with white of egg.
(4) Compare sulphur with white of egg.
(5) Compare phosphorus with flesh of fish.
3. Except in the case of oxygen, these elements can be used by the body only in their compounds.
*b*) Uses made by the cells of these compounds of the elements.
1. Those rich in carbon for energy—heat, work.
*aa*) Study the oxidation of carbon and the products.
2. Those rich in nitrogen for building material and energy.
3. Study the chemical composition of starch, sugar, protein, and fats to determine their efficiency as foods.
4. Learn the chemical tests for these foods.
5. Classify by test a large number of common foods as to their use in the body.
*c*) A study of dietaries.
1. Necessity of knowing what foods furnish the desired elements in the right proportion.
2. The calorie values of foods.
*aa*) Chittenden, Voit, and Atwater tables.
*bb*) 100-calorie portions table. (Fisher.)
3. Plan balanced meals.
*aa*) As influenced by different occupations.
*bb*) To get highest nutrient value at lowest cost.

II. The preparation of foods.
*a*) Why foods are cooked.
1. To kill parasites and bacteria.
2. To conserve the nutrient factors.
3. To promote digestibility.
4. To render the food more palatable.
*b*) The importance of proper cooking to gain these ends.

III. The care of foods.
*a*) See outline of work in Eighth Grade (Household Science).

D. Digestion.
  I. In the mouth.
    *a*) Mastication and insalivation.
      1. Structure, function, and care of the teeth.
        *aa*) Comparative study of teeth.
          (1) As suggestive of kind of food required.
      2. Structure, location, and function of the salivary glands.
        *aa*) The saliva—ptyalin.
          (1) Change of starch into a soluble compound.
      3. Importance of thorough mastication and insalivation.
        *aa*) Apply starch and sugar tests to:
          (1) Starch food (bread) not masticated.
          (2) Starch food partially masticated.
          (3) Starch food thoroughly masticated.
        *bb*) Effects of acid fruits on action of ptyalin.
        *cc*) Effects of cold water on action of ptyalin.
        *dd*) Fletcherism—its significance.
  II. In the stomach.
    *a*) The gastric digestion. Change of protein to peptone.
      1. Location, size, shape, anatomy of the stomach.
      2. Glands, juices, and motions of the stomach.
      3. Conditions which promote the normal progress of gastric digestion.
        *aa*) Proper mastication and insalivation.
        *bb*) Proper temperature of foods.
          (1) Effects of ice-water and other cold foods.
        *cc*) General good health.
        *dd*) Normal appetite.
        *ee*) Palatability of foods.
        *ff*) Freedom from worry.
      4. Medicines as aids to digestion.
        *aa*) Unnatural, showing abnormal condition.
  III. In the intestines.
    *a*) Completion of other processes; emulsification of fats.
    *b*) Importance to health of normal action here.
      1. Residues of food must be eliminated.
    *c*) Form, structure, and function of the intestines.
    *d*) The glands and fluids which contribute to intestinal digestion.
      1. The liver and the bile.
      2. The pancreatic juice.
    *e*) Conditions which tend to clogging of the intestinal tract.
      1. Insufficient water as food.
      2. Insufficient exercise.
    *f*) Remedial foods.
      1. Fruits. Entire grain cereals. Vegetables.
    *g*) Auto-intoxication.
      1. Causes.
        *aa*) Improper mastication.
        *bb*) Inefficient peristaltic movement of intestines.
          (1) Due to lack of salts in food.
        *cc*) Unclean food.

2. Results.
*aa*) Poisoning of various types.
(1) Hives.
*bb*) Indigestion.

IV. Absorption.
*a*) What becomes of the digested food?
1. The villi.
*aa*) Osmosis.
(1) Experimental study of.
2. The lacteals.

V. Effect upon the digestive organs and processes of using contaminated foods.
*a*) Diseases of the digestive tract.
1. Dysentery, diarrhea, cholera infantum, typhoid fever, indigestion, appendicitis, etc.
*aa*) Importance of sterilizing all discharges in bacterial diseases of the digestive tract.

E. The circulatory system.
I. Necessity for.
*a*) Compare to river system carrying supplies to individuals and communities. (Cells.)
*b*) How the digested food gets into the circulatory system.
1. The portal circulation.

II. Circulation in frog's foot.

III. Structure and action of the heart.
*a*) Work out the mechanics of the valves.

IV. Structure and uses of the blood tubes.
*a*) Arteries.
*b*) Capillaries.
*c*) Veins.

V. The blood.
*a*) Its composition and properties.
1. The corpuscles and their function.
*aa*) Number of corpuscles.
(1) Anemia.
*b*) Ability of cells to select needed materials from blood.

VI. The lymphatic circulation.

VII. Diseases of the circulatory organs and of the blood.
*a*) Heart disease.
1. Effects of overexertion.
2. Influence of indigestion.
*b*) Blood poisoning.
*c*) Fevers, etc.
*d*) Effects of alcohol.

VIII. The purification of the blood.

F. The respiratory system.
I. The organs of respiration.
*a*) Nasal passages, larynx, trachea, lungs, bronchial tubes.
1. Special study of structure of lungs.

II. The mechanics of respiration.
  *a*) Expansibility of air.
  *b*) Illustrate the mechanics of breathing.
  *c*) Lung capacity by use of simple apparatus.
III. The composition of "pure" air.
IV. The composition of exhaled air.
  *a*) Explain difference on basis of oxidation.
V. Importance of abundance of pure air.
  *a*) To maintain energy—heat.
  *b*) Amount of fresh air necessary for each individual.
    1. Ventilation.
      *aa*) Necessity and methods.
  *c*) Deep breathing.
    1. By chest expansion.
    2. Necessity of loose clothing.
VI. Diseases of the respiratory organs.
  *a*) Colds, bronchitis, catarrh, sore throat, adenoids, tonsilitis, pneumonia, diphtheria, tuberculosis.
  *b*) Illustrate bacterial character by means of culture plates.
  *c*) The resistant properties of tuberculosis bacilli.

TUBERCULOSIS

1. Graphic illustration to show prevalence.
   Estimate cost to the country.
2. Study of known characteristic case.
3. Cause and nature of disease.
   *aa*) Parts of body attacked.
   *bb*) Germs—thorough elementary study.
   *cc*) Contagion:
   Sputa.
   Dried sputa carried in dust.
   Spreads through use of water, drinking-cups, books, pencils, carried by flies and pests, found in milk of affected cows.
4. Means of prevention.
   Avoid promiscuous spitting.
   Keep body strong.
   Secure milk and food from sources known to be clean.
   Keep all avenues closed to germs so far as possible.
5. Treatment.
   Early attention.
   Live in the open.
   Complete rest.
   Climatic benefits.
   Nourishing food.
   Skilled medical attendance.
   Sanatariums.
   Avoid patent medicines.
   Avoid alcohol.

G. The skin and excretion.
  I. Structure and function of the skin.
    *a*) The skin as a protection.
    *b*) The elimination of waste products.
      1. The perspiratory system.
    *c*) The regulation of the body temperature.
      1. The heat effects of evaporation.
  II. Hygiene of the skin.
    *a*) Importance of bathing.
    *b*) Care as to scratching and rubbing.
      1. Provides for entrance of bacteria.
    *c*) Need of proper clothing for protection.
      1. Study "warmth" properties of clothing.
        *aa*) Conductivity of such textiles as wool, cotton.
        *bb*) Heat properties of various colors. (Experiment.)
  III. Structure and functions of the kidneys.
  IV. Diseases of the kidneys.
    *a*) Bright's disease.

H. The skeletal system.
  I. Shapes of bones dependent upon their function.
  II. The uses of the bones.
    *a*) For protection.
    *b*) As levers for action of muscles.
      1. Study classes of levers and classify levers of body.

K. The muscles.
  I. The characteristic property of muscle.
    *a*) Contractility.
  II. The relation of muscle to exercise.
  III. The limitations to the value of exercise.

L. The nervous system.
  I. The parts and their functions.
    *a*) The brain, spinal cord, nerves, ganglia.
    *b*) Illustrate with dissection of frog.
  II. The relations of the nerves to the other organs.
  III. Diseases of the nervous system.
    *a*) Alcoholism.

M. The organs of special sense.
  I. The eye.
    *a*) The elements of optics. Lenses.
    *b*) The parts and functions.
    *c*) The care of the eyes.
    *d*) Glasses.
  II. The ear.
    *a*) Its structure and function.
    *b*) Care.
    *c*) Diseases.
      1. Earache.

III. The sense of taste.
IV. The sense of smell.

N. Reproduction.
I. Reproduction in such plants as yeasts and bacteria.
II. Reproduction in higher plants.
III. Embryology of frog and chick.

## SUGGESTION FOR ELEVENTH AND TWELFTH YEARS

ELEVENTH YEAR, PHYSICAL AND CHEMICAL SCIENCES. TWELFTH YEAR, BIOLOGICAL SCIENCES

## BOOKS WHICH MAY BE OF AID IN THE SUGGESTED COURSE OF STUDY

GENERAL GEOGRAPHICAL ASPECTS

Geographical Series, by Herbertson.
Geographical Series, by Carpenter.
Series of Food, Clothing, etc., by Chamberlain.
Place of Industry in Education, by Dopp.

GENERAL HOUSEHOLD, BIOLOGICAL AND AGRICULTURAL, ETC.

Bulletins of Our Illinois State Laboratory. Bulletins of the U.S. Department of Agriculture and Bulletins of the Various State and College Experiment Stations.
Conn, Bacteria, Yeast, Molds.
———, Bacteria in Relation to Country Life.
Duggar, Plant Diseases.
Coulter, Plant Life and Plant Relations.
Jordon, Animal Life.

TECHNOLOGICAL: LUMBER, TEXTILES, METALLURGY, DYEING, CLAYS, ETC., ETC.

Cassell & Co., Technical Series.
Wiley & Co., Technical Series.
George Bell & Sons, Technical Handbooks.
Matthews' Books on Textiles (Wiley & Co.).

PHYSIOLOGY, HYGIENE, ETC.

Gulick's recent books.
Hoag, Health Studies.
Hough & Sedgwick, The Human Mechanism.
Prudden, Water and Ice.
———, Dust and Its Dangers.
Elliott, Household Hygiene.
———, Household Bacteriology.
Millard, The Wonderful House That Jack Has.
Allen, Civics and Health.
Millikan and Gale, First Course in Physics.
Harrison, Lessons on Sanitation.
Price, Handbook on Sanitation.
Cotton, Care of Children.
Pope, Home Care of the Sick.
Ravenhill, Practical Hygiene.
Cornell College, Bulletins of Farmers' Wives' Reading Courses.

# EDITORIAL NOTES

**Co-operative Tests in Arithmetic**

The *Elementary School Teacher* is glad to give as wide publicity as possible to an announcement made by Mr. S. A. Courtis of the Home and Day School, Detroit, Michigan. Mr. Courtis has put his arithmetic tests, which will be familiar to readers of this journal, into such form that they may readily be utilized by supervisors or principals. He is now planning to make a general investigation covering as many schools as he can reach. He wishes to announce that he will distribute 10,000 sets of his standard tests, together with the necessary instructions for the use of these tests, to schools. Up to this number he intends to distribute the material free of charge. He is also prepared to furnish the same material at cost to any workers who may be willing to co-operate on this basis in their schools. He has had the tests plated, so that the preparation of reproductions will be very simple and economical. The actual working time required for a grade is twenty-four minutes. The instructions to the children on taking up the papers will, however, consume some time, and Mr. Courtis recommends that the test be tried in two sections, one part each day. He has prepared record sheets for the compilation and stating of results. He finds that the time required for scoring, entering, and computing the average grades and variability of groups of fifty children does not exceed two hours.

**Valid Method for Such Tests**

The project which Mr. Courtis has undertaken is somewhat novel. We are familiar with tests that have been made by individual students in various departments, but an effort to secure the co-operation of a large number of superintendents or teachers for the use of a carefully prepared series of tests promises much for our educational system, if it can be successfully carried out. The difficulties which arise in attempting to compare the results of tests of this sort are well known to educational investigators

If the tests are not conducted in uniform manner at different centers, and if the results are not computed in exactly the same way, comparisons are misleading. The value of the method, therefore, is one of the chief considerations. Mr. Courtis has given this question of method much attention. He has a large array of careful workers who are prepared to stand sponsors for the efficiency of his method. The *Elementary School Teacher* has published three of Mr. Courtis' articles, and the present writer has examined carefully the tests which he has prepared, and we believe there should be the largest confidence for these tests.

C. H. J.

**Report of Committee of Seven**

This number of the *Elementary School Teacher* carries out the arrangement with the Northern Illinois Superintendents' and Principals' Association, which was announced in February. The full report of the Committee of Seven is presented. This report will be discussed at the May meeting.

**Enthusiasm for Nature-Study**

The subject of the report is one which is commanding a great deal of attention in the educational world at the present time. A generation ago the suggestion came from Germany that concrete material should be more freely used in the schools. This suggestion was received with enthusiasm by a few elementary school teachers and supervisors. In the meantime in our higher institutions of learning science was beginning to gain a foothold. Physics, chemistry, and biology were seen to be productive for practical life and suitable for mental discipline. Spencer's *Essays on Education* set forth in vigorous terms the advantages of studying science, and the enthusiasm which had been fostered by discussions of concrete education was increased in intensity and taken up by a larger circle of teachers. Finally, the practical world with its dependence on science for its new mechanical devices and for the principles underlying its development began to make a demand on the schools for the training of children in these lines. This demand gave a new impetus to the movement, and the introduction of nature-study was under-

taken as one of the most promising educational innovations of the day.

**Criticism of Nature-Study**

The experiment has been under way for some time, and the enthusiasm with which many teachers took up the work has waned, if not disappeared entirely. Several systems of nature-study have had their day, and dropped out of sight. Several guiding principles of selection have been advocated, accepted, tried, discarded, and finally forgotten, except by the student of educational history. We have now reached the period of serious reconsideration. The enthusiasm of extreme youth is gone; there is a frank recognition of serious difficulties, and on the whole a better and safer attitude of conservative study of the problem.

**Social Interests of Young Children**

It is perhaps pretentious for the writer to attempt to add, by way of editorial comment, to the discussion of the committee, but there is one consideration which is significant and so likely to be overlooked by the specialist that it may be worth setting down as a part of the debate. It is not true that a child's strongest impulse is in the direction of attention to natural objects. A child is absorbed in people more than in things. A child's interest in color always attaches itself to some person. Children want the things that they see other children have. Social observation is very keen, at least as early as observation of objects. When observation of objects begins, it is superficial. It is guided by accidental motives, not by any principles of scientific analysis. For these reasons young children will not study objects in the lower grades with the devotion which they can be induced to show in the pursuits of the social arts, such as reading and writing. Sometimes conservative teachers have bewailed the competition between the newer subjects and the fundamental social arts. There is no need of anxiety. The fundamental arts of reading, writing, and number have demonstrated their vitality so fully that they can be relied on to outlive any excess of enthusiasm in other directions. The fundamental fact of human nature is that social interests are the most potent interests. Indeed, science is the formulation of certain principles of

the relation between the external world and the scientific thinker. Science does not come from without. It is cultivated from within. There is some danger that the advocates of nature-study will forget this dependence of science upon inner motives. They forget that the child cannot get science from things. Science is the best and most productive thought of man. Science deals with things, but it is not made by things nor dictated by things. Things have always been in the world, but science is very young; it came through co-operative human thinking. The present writer believes that such considerations show the necessity of much training in language as a means of scientific progress. He would look for a check in the nature-study movement so long as that movement over-emphasizes things.

C. H. J.

# CURRENT EDUCATIONAL LITERATURE IN THE PERIODICALS[1]

IRENE WARREN
Librarian, School of Education, The University of Chicago

ANGELL, JAMES R. William James. Educa. Bi-mo. 5:189–92. (Fe. '11.)

ARNOLD, FRANK R. College stagecraft. Educa. 31:466–71. (Mr. '11.)

BAGLEY, W. C. The present status of moral education in institutions for the training of teachers. Relig. Educa. 5:612–40. (Fe. '11.)

BAKER, MARGARET. Teaching English to foreign students at Oxford. Educa. Bi-mo. 5:205–14. (Fe. '11.)

BAUR, EVA E. VON. Trade education in Germany: its value to the laborer. Craftsman 19:598–607. (Mr. '11.)

BLACK, JESSIE ELIZABETH. Practice in literary form in advanced grades. Educa. Bi-mo. 5:237–41. (Fe. '11.)

BLOCK, LOUIS JAMES. The study of English literature in the secondary schools. Educa. Bi-mo. 5:215–19. (Fe. '11.)

BROADUS, ELEANOR HAMMOND. An experiment in education. Educa. Bi-mo. 5:242–48. (Fe. '11.)

CABOT, ELLA LYMAN. Moral instruction and training in the schools of Massachusetts. Relig. Educa. 5:663–70. (Fe. '11.)

CARROLL, CLARENCE F. Moral instruction and training in the public schools of New York. Relig. Educa. 5:640–44. (Fe. '11.)

CASSIDY, MASSILLON ALEXANDER. A Kentucky experiment. Relig. Educa. 5:702–4. (Fe. '11.)

COLEMAN, NORMAN F. Moral instruction and training in the state of Washington. Relig. Educa. 5:689–93. (Fe. '11.)

Curriculum of training colleges. School W. 13:41–43. (Fe. '11.)

DE BEY, CORNELIA B. A pedagogic thought from Darwin. Educa. Bi-mo. 5:229–36. (Fe. '11.)

The evils of overteaching. Educa. R. 41:232–37. (Mr. '11.)

FITE, WARNER. The case of the college professor. Pop. Sci. Mo. 78:273–82. (Mr. '11.)

[1] *Abbreviations.*—Educa., Education; Educa. Bi-mo., Educational Bi-monthly; Educa. R., Educational Review; El. School T., Elementary School Teacher; Harper, Harper's Magazine; Journ. of Educa. (Bost.), Journal of Education (Boston); Journ. of Educa. Psychol., Journal of Educational Psychology; Liv. Age, Living Age; Pop. Sci. Mo., Popular Science Monthly; Print. Art, Printing Art; Psychol. Clinic, Psychological Clinic; Relig. Educa., Religious Education; School W., School World; Teach. College Rec., Teachers College Record; Univ. of Chic. Mag., University of Chicago Magazine.

FITZGERALD, ELLEN. The schoolmaster as a writer. Educa. Bi-mo. 5:220–28. (Fe. '11.)

FITZWILLIAM, SARAH E. RAYMOND. An educational reminiscence. Educa. Bi-mo. 5:193–200. (Fe. '11.)

GORDY, WILBUR F. Influence of local conditions upon the moral aim dominant in the state schools. Relig. Educa. 709–14. (Fe. '11.)

GRAY, DAVID. A modern temple of education: New York's new public library. Harper 122:562–76. (Mr. '11.)

GREENWOOD, J. M. The home and school life. Educa. 31:390–96. (Fe. '11.)

HANEY, JAMES PARTON. Industrial education. Educa. 31:436–43. (Mr. '11.)

HARPER, CHARLES F. How can the high school serve more effectively the interests of the community? Educa. 31:355–69. (Fe. '11.)

HAYES, CARLTON HUNTLEY. History in the college course. Educa. R. 41:217–31. (Mr. '11.)

HICKS, VINNIE CRANDALL. A study of a subnormal child. El. School T. 11:296–307. (Fe. '11.)

HILL, ALBERT ROSS. Some successes and failures of the American college. Univ. of Chic. Mag. 3:127–37. (Ja. '11.)

HODGSON, GERALDINE. Education in citizenship. School W. 13:47–49. (Fe. '11.)

HOSIC, JAMES FLEMING. Recent educational conferences. Educa. Bi-mo. 5:201–4. (Fe. '11.)

JOHNSON, FRANKLIN W. Significant experiments in the state of Illinois. Relig. Educa. 5:696–702. (Fe. '11.)

JOHNSON, HARROLD. Moral education in schools: an international problem. Relig. Educa. 5:704–8. (Fe. '11.)

KENT, ERNEST B. Manual training and local industry, a course of study for boys of the two upper grades. Educa. 31:374–83. (Fe. '11.)

LAIRD, RAYMOND G. The commercial high-school curriculum. Educa. 31:456–65. (Mr. '11.)

MURRAY, E. R. A short history of infant schools and kindergartens in England (1). Child Life 13:7–10. (Ja. '11.)

PEGRAM, GEORGE B. The attitude of the newer physics toward the mechanical view of nature. Educa. R. 41:290–302. (Mr. '11.)

PERKINS, HENRY A. The educational system of France. Educa. R. 41:245–60. (Mr. '11.)

PLATT, S. The meaning and value of co-education. Child Life 13:11–15. (Ja. '11.)

Professor S. H. Butcher. Educa. R. 41:280–89. (Mr. '11.)

PYLE, W. H., AND SNYDER, J. C. The most economical unit for committing to memory. Journ. of Educa. Psychol. 2:121–32. (Mr. '11.)

RANCK, CLAYTON H. Self-help among college students. Educa. 31:444–48. (Mr. '11.)

RAVENHILL, ALICE. The play-interests of English elementary-school children. Child 1:217–26. (D. '10.)

ROUSE, W. H. D. The place of classics in secondary education: a reply. Liv. Age 50:103–6. (14 Ja. '11.)

RUGH, C. E. Moral instruction and training in the schools of California. Relig. Educa. 5:644–63. (Fe. '11.)

SANDIFORD, PETER. Day training colleges in England. School W. 13:52–54. (Fe. '11.)

SEASHORE, C. E. The consulting psychologist. Pop. Sci. Mo. 78:283–90. (Mr. '11.)

SHARP, FRANK CHAPMAN. Moral instruction in certain high schools and normal schools of Wisconsin. Relig. Educa. 5:693–95. (Fe. '11.)

SHOW, ARLEY BARTHLOW. Historical significance of the religious problem in the German schools. Educa. 31:423–36. (Mr. '11.)

SISSON, EDWARD O. Can virtue be taught? Educa. R. 41:261–79. (Mr. '11.)

SMILEY, W. S. A comparative study of the results obtained in instruction in the "single-teacher" rural schools and the graded town schools (2). El. School T. 11:308–22. (Fe. '11.)

Stage children. Dial 50:145–47. (Mr. '11.)

STERN, WILLIAM. The supernormal child (1). Journ. of Educa. Psychol. 2:143–48. (Mr. '11.)

STRAYER, GEORGE D. The legal aspect of moral education. Relig. Educa. 5:599–611. (Fe. '11.)

SUZZALLO, HENRY. The teaching of primary arithmetic. Teach. College Rec. 12:5–70. (Mr. '11.)

TAYLOR, CHARLES KEEN. Boys' backs. Psychol. Clinic 4:274–76. (Fe. '11.)

TAYLOR, J. MADISON. Motor education for the child. Pop. Sci. Mo. 78: 268–72. (Mr. '11.)

Teacher's salary report. Journ. of Educa. (Bost.) 73:117–19. (2 Fe. '11.)

THOMAS, CHARLES SWAIN. New England association of teachers of English. Educa. 31:384–89. (Fe. '11.)

University training for printers. Print. Art 16:448. (Fe. '11.)

UPTON, HENRY L. The problem of public education. Educa. 31:397–403. (Fe. '11.)

WALLIN, J. E. W. The new clinical psychology and the psycho-clinicist (1). Journ. of Educa. Psychol. 2:121–32. (Mr '11.)

WEISSE, H. V. The educational ladder. School W. 13:45–47. (Fe. '11.)

WELSH, CHARLES. The outlook in teaching history. Educa. 31:370–73. (Fe. '11.)

WILSON, M. C. Some defects in our public school system. Educa. R. 41:238–44. (Mr. '11.)

WITMER, LIGHTNER. Courses in psychology at the summer school of the University of Pennsylvania. Psychol. Clinic 4:245–73. (Fe. '11.)